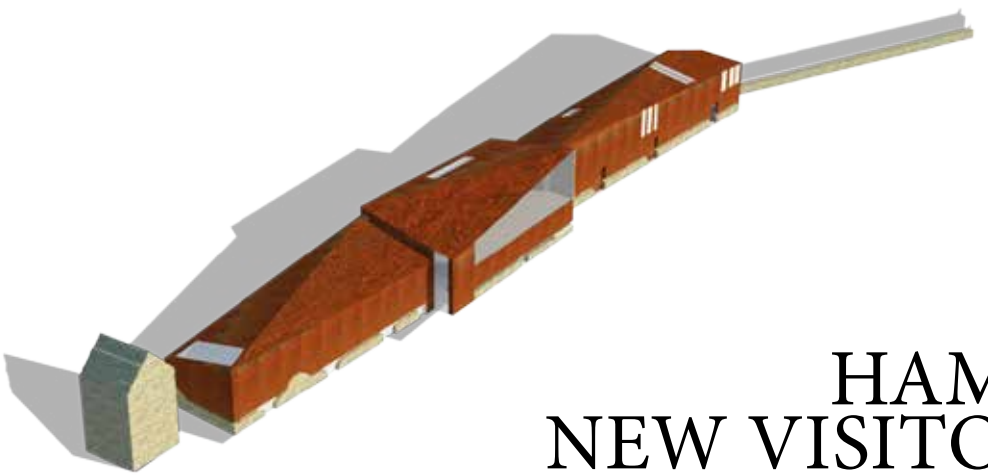


HAMMERSHUS
NEW VISITOR CENTRE

ABSTRACT

This paper is concerned with the transformation process of Hammershus from an old ruin into a modern visitor centre that fulfill the needs of today. The communication of the history of Hammershus has been the focal point throughout the whole project. This includes the history of the location, the original purpose of the castle and the communication of the history of the new building. In the work with the new visitor centre the transition from a busy tourist attraction into spatialities, where concentration and contemplation is possible has been in focus. In addition to the architectural principles, there has been assigned to a sustainable approach.

The making of the visitor centre is based on Naturstyrelsens program for a new visitor centre at Hammershus and take their requests and demands as its starting point.

Jonas Holmgaard Hundebøl

Hammershus New Visitor Centre
Thesis project, MSc4, ARK
Architecture and Design
spring 2013

Supervisor: Peter Mandal Hansen
Technical supervisor: Rasmus Lund Jensen
Copies: 4
pages: 123

INTRODUCTION

Naturstyrelsen did in 2012 get approval from A.P Møller og Hustru Chastine Mc-Kinney Møllers Fond til almene Formaal regarding financial support on 92,5 million kroner for a hole project that both preserve and extend the presentation of the ruin of Hammershus.

The project includes restoration of the ruin (28 million kroner), building of a new visitor centre (64,5 million kroner) and demolition of existing buildings in front of the ruin. In this way Naturstyrelsen wants to make modern surroundings for communicating the stories about Hammershus and the landscape near by, concurrent with preserving the ruin. (Naturstyrelsen, 2012:1)

1st. of April 2013 a closed competition for building began. This 10th. Semester project will be based on the competition. The site however has been moved from where the competition is held. Instead the new site is on the top of the cliff in the ruin of Hammershus. This is done to, as described in the report, make a more central placed Visitor Centre. In this move the project has to deal with clash between old ruin and modern visitor centre.

Through out the whole project the main words are presentation and communication. These words are both representing the museum and its exhibitions and also the building itself.

Besides the architectural part, the building devolpment also has a technical dimension, in which the technical numbers meats the architectural visions. This technical part is incorporated in to the the project in a integrated process.

CONTENTS

Ill. 2: A sign

DESIGN METHOD

To fulfil the demands for the new visitor centre at Hammershus both architectural and technical solutions are needed. To combine both approaches an integrated design process is necessary. To organise such a process Mary-Ann Knudstrup has developed a method called Integrated Design Process in problem-based learning.

"In this model the traditional architecture and engineering disciplines are split into different components, and some of the components from engineering are combined with the architecture components into a new method. This is what I call the Integrated Design Process."

(Knudstrup, 2004:3)

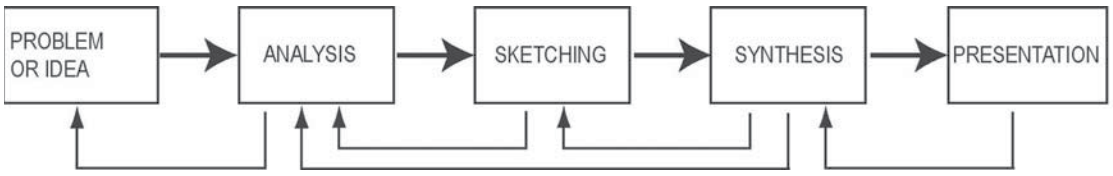
Mary-Ann Knudstrup continue and put this quote in to a scheme. In the scheme the project phase starts with an idea or a problem and then runs through different phases before ending up with a solution (Knudstrup, 2004:4-7) as shown on Ill 3: Design Method. The integrated design process is not a continuous process, where you move in a strait line from A to B, but instead a process, where you make iterations of the project several times. In this iteration you take different points of view. This is done to secure that both the architectural part and the enginering have an effect on the final product. And specially the skecthing phase is important in integrated design.

"The Sketching Phase is the phase where the professional knowledge of architects and engineers is combined and provide mutual inspiration in the Integrated Design Process."

(Ibid)

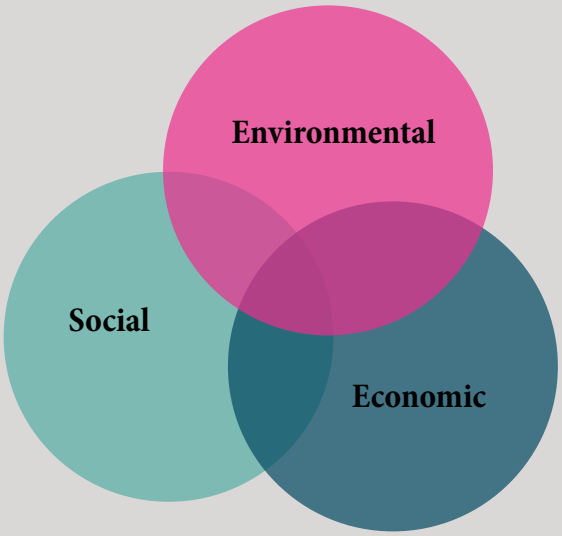
To fulfil the best integration of both architectural and engeneering approaches to one solution: A New visitor centre. This project therefor works with the method made by Mary-Ann Knudstrup in a process simular to the one shown on illustration 3.

In this report the most important iterations are shown. This is done for better communication of the final product. For clarity the integrated design process has been cut down to three overall subjects. These subjects are also the main paragraphs in this report, that is Program, Design phase and Presentation.



Ill. 3: Design Method (Knudstrup, 2004:4)

SUSTAINBLE APPROACH



Ill. 4 Sustainability

In the later described "Overall competion demands", one of the goals to reach is to create an eco-friendly visitor centre at Hammershus. Within the word eco-friendly is also thought of a sustainable dimension. Sustainability therefor plays a part in the design of the new visitor centre. In order to integrate sustainstainability in the design, it is important to increase the exact definition of sustainability:

In October 1987 UN released the Brundtland report. The Brundtland report should among other things try to define sustainability. The report contains hence the nowadays most used definition of sustainable development:

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"(UN, 1987).

This definition has since 1987 gone through a change, and is today divided in to three approaches: environmental sustainability, economic sustainability and socio-political sustainability (Sustainable development, 2013).
The relation between the three pillars should not be seen exclusively, but as a mutually reinforcement of each other with an equally focus. In the centre of this reinforcement sustainability then exists (see illustration).

On basis of the three approaches there has been made a report called "Kortlægning af bæredygtigt byggeri, (Birgisdottir, Mortensen m.fl., 2013)". This report describes the approaches from an architectural point of view. Based on each approach is then described factors that relates to exact these approaches.

An example could be:

The economic approach:
-Building where area utilisation is optimised (Birgisdottir, Mortensen m.fl., 2013:10)

From these the factors relating to each of three approaches have I then chosen the most relevant goals for creating a new visitor centre on Bornholm and rewritten them in to a relevant context where it is needed. As a rule all factors is equal an needed to create sustainable architecture in the definition of Birgisdottir and Mortensen, but for this project I have left out some factors. This done because, many of these factors first gets incorporated on a higher detail level than this project will relate to. For instance relting to the environmental approache

- Byggeri hvor brug af farlige kemikalier er reduceret eller undladt. (Birgisdottir, Mortensen m.fl., 2013:10)

Therefor will the sustainable approaches and factors defining this project be as listed on opposite page.

Ill. 5 Nature at Bornholm

The environmental approach:

- As low energy use as possible without negative consequences for the architecture.
- For limitation of the energy use in the visitor centres preface local materials is used if possible.
- If possible recycling of the existing buildings is used.

The social approach:

- Flexibility of the building, so that the use of the building can change in the future.
- Good comfort in relation to indoor climate.
- Architecture where experiences and use are supported by great architecture and good outdoor facilities.

The economic approach:

- Optimisation of the use of square metres.

Program

The following paragraphs are a part of the analysis and are used to understand the context in a more detailed way. As a part of the program every paragraph has it one conclusion, where it is described which effected the concluded have or will have on the design of the new visitor centre.

OVERALL COMPETITION DEMANDS

In the competition program from Naturstyrelsen (Naturstyrelsen, 2013:13-17) a list of demands to the new visitor centre are lined up. These demands both relate to the overall demands and the more specific demands. As written in the following "general request", "presentation and communication concept" and "environmental and technical demands" texts in this paragraph the demands cover the overall demands relating to the new visitor centre. From those demands three overall demands stand out. These demands for the new visitor centre are by Naturstyrelsen chosen to be:

- The relation to landscape and the existing ruin and hierarchy between those

-The communication and presentation in the new visitor centre

-A sustainable profile

These three subjects will therefore be the main subjects for the new visitor centre. Therefor it is also those three subjects that are investigated later in the program. When only these three themes are described as this point in the report, it is because, they define the overall thoughts related to the new visitor centre as described by Naturstyrelsen. In the following program phase the detailed demands from Naturstyrelsen will be described. This among other things counts the specific room demands and square metres.

Texts are translated from the program; send out by Naturstyrelsen (ibid). Some parts of the texts have been left out. This is done because, it is on a detail level this project won't reach.

General requests

The visitor centre has to place itself into a hierarchy between Hammerhus and the surroundings. The landscape and its surroundings are the fundamental elements in the experience of the area around Hammershus. The experience of the dramatic landscape is compounded by the fact that Hammershus is placed in a higher level and therefore dominates its surroundings. Furthermore it is requested that the visitor centre is designed to accommodate 300 visitors at a time. This means that the spatialities have to be proportioned and orchestrated in such a way that the visitors are guided through the exhibition in an eventful, pleasant and appropriate way.

Presentation and communication concept

The visitor centre should respect the castle as the dominating centre in the area and therefore it has to support and supplement the visit by providing an overview and create a link between the castle and the landscape.
In this way the visitor centre should function as a portal that gives a common introduction. The communication of the historical material should be represented in a way that activates the visitor through association and interpretation. At the same time, the visitor should gain insight into factual information and closed conclusions that give an anchor. The communication should be differentiated so that visitors with diverse qualifications will win by the visit.
The visitors should be challenged through their fantasy and creativity so that a dialogue between the visitors and the attraction will be established. It is important that the spatialities of the new visitor centre are as flexible as possible and they should appear attractive and workable. Furthermore, there should be vast possibilities for flexible use of digital techniques. The solutions for illumination should create an interaction between dark and bright panoramic parts, which creates a link between the castle and the communication of it. The visitors should have the experience of being invited into the castle from the exhibition and the other way around.

Environmental and technical demands

The visitor centre should be realised through eco-friendly project design. The design should furthermore account for the technical possibilities and demands for realising the specific building in low energy demands 2015 and 2020.

There must be implemented a green energy solution, which reduce the burden of the future budget. The ventilation should as far as possible be based on mechanical helped natural ventilation.

Heating should be based on rock heating.

BORNHOLM AND HAMMERSHUS

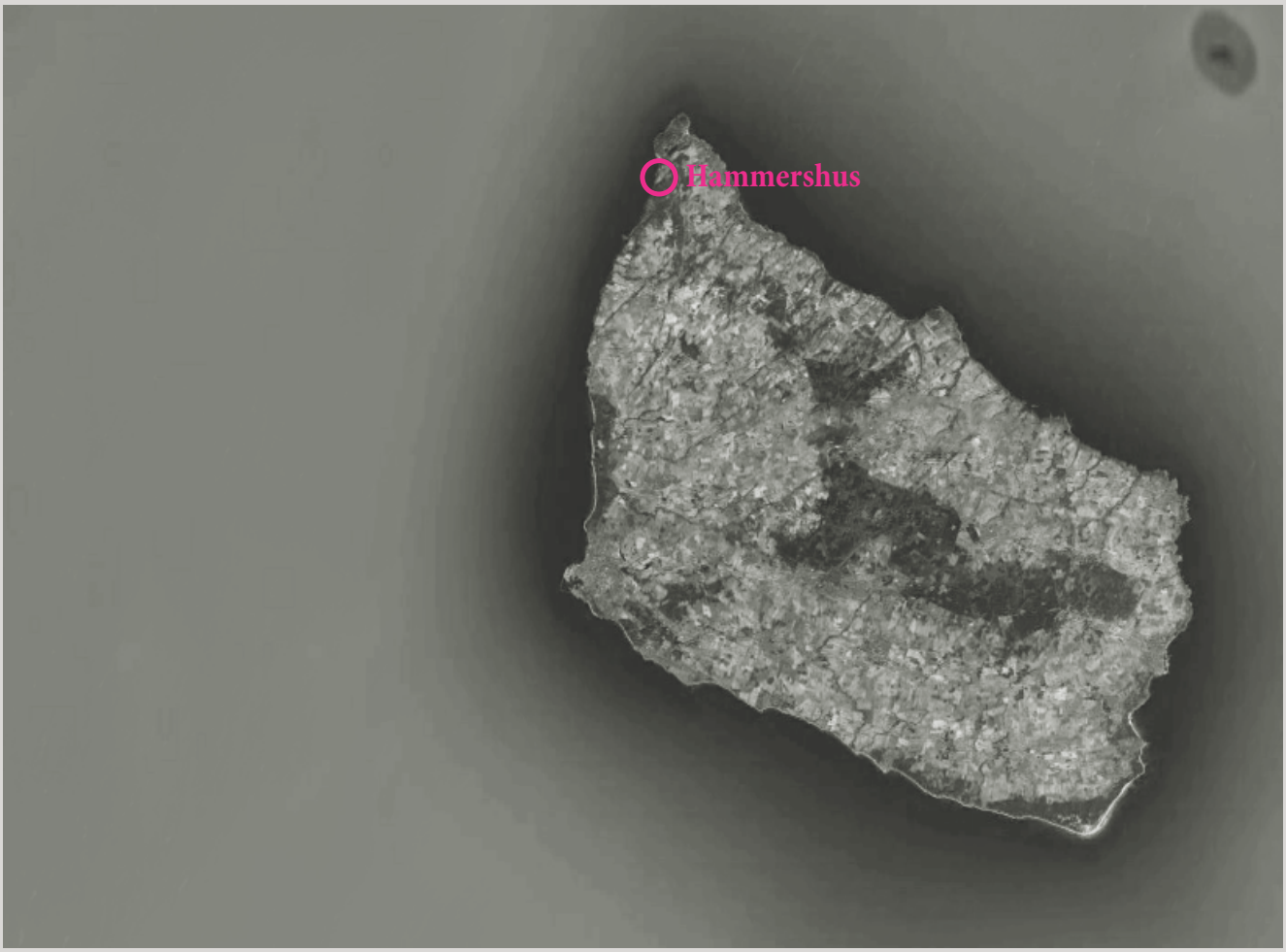
Bornholm, the place for the new visitor centre, is a Danish island in the beginning of the Baltic Sea, south of Sweden, and north of Poland. The main industries on the island include fishing; arts and crafts such as glass making and pottery using locally worked clay, and dairy farming. Tourism is important during the summer. The topography of the island consists of dramatic rock formations in the north sloping down towards pine and deciduous forests (greatly damaged by storms in the 1950s), farmland in the middle and sandy beaches in the south.

Bornholm Regional Municipality covers the entire island. Bornholm was one of the three last Danish municipalities not belonging to a county— the others were Copenhagen and Frederiksberg. On 1st. of January 2007, the municipality lost its short-lived (2003 to 2006) county status and became part of Region Hovedstaden.

Strategically located in the Baltic Sea, Bornholm has been fought over for centuries. It has usually been ruled by Denmark, but also by Lübeck and Sweden. The Hammershus castle ruin, at the northwestern tip of the island, is the largest medieval fortress in northern Europe, testament to the importance of its location. Every year between 300.000 and 400.000 people visit the ruin. It is the most popular attraction on Bornholm. (Wikipedia, 2013a)

At Hammershus there is at the moment an existing exhibition. The existing exhibition consists of an informative exhibition. The space for the exhibition area is about 150 square metres and contains models, planches and an open auditorium for teaching of school classes. Approximately 20.000 people visit the exhibition every year. (Bjerregaard, 2013)In the farm is also placed toilets for the visitors of Hammershus and a small restaurant that serves small menus and sell souvenirs.

When the new visitor centre is build, the existing farm is going to be removed, and the spatiality's from there will be moved to the new visitor centre.



Ill. 6: Bornholm

HAMMERSHUS AS CASTLE AND RUIN

To create the best communication and presentation in the new visitor centre it is important to know the story of the site. This can also help define the very exact spot where to build the new visitor centre.

Hammershus was built in the early 13th century. The castle played an important role in the many conflicts between the archbishops and the kings through the 13th and 14th century. Several times the king did conquer Hammershus, but every time he had to give it back to the archbishop more or less willingly. Last time was in 1326 when Valdemar Atterdag gave the castle to the bishop. In return the king did demand the bishop to give back Hammershus, when the king wanted it so. This happened in 1522

As lord of Hammershus the archbishop could collect taxes and fee from the islands farmers and craftsmen. This was normally done in provisions and working hours.

In 1526 Lübeck's captured Bornholm and the castle after a series of attacks. The Danish king then gave the Lübeck's Hammershus in security for protection. Then the Lübecks themselves was interested in keeping Hammershus up to date. Due to new advanced military the Lübecks did then build the half round towers(Ill. 4), upgrade wall the inner walls and left the outer walls.

The deal including the security ran out in year 1576 and Hammershus got back on Danish hands. For a short period in the 17th century the Swedish occupied Bornholm. Hammershus retained its role of defending Bornholm right up until the end of the 17th century, when the defence of Denmark's easternmost territory passed to the defences on Christiansø and at Rønne. Illustration 8 pictures how Hammershus is thought to look like before it was abandoned.

In 1743 Hammershus was finally abandoned and was at that time already rundown. Hammershus did then end up as a giant pit, where the people of Bornholm were free to gather building materials. In 1822 the ruins were put on the national historic register. And was from that time preserved.

Hammershus is the biggest castle ruin of Northern Europe. As the castle appear today is a result of hundred of years of additions, modifications, demolitions and disrepair. The time around 16th century was the glory days of the castle. At that time the castle was a big complex with a central fortress surrounded by three pre-castle walls. Inside the walls Hammershus contained a bunch of different functions. There were warehouses, stables, workshops, brewery, bakery, church, and buildings for soldiers, servants and family. Together all these functions became a self-sufficient unit. (Miljøministeriet, 2007)

For summing up the history of Hammershus can be divided into five periods:

1. Period under Danish king and the archbishop of Lund. - From beginning of 13th century until year 1522

2. Period under the Lübeck's. From year 1526 until year 1575

3. Period under the vassel. From year 1576 until beginning of 18th century

4. Period when abandoned. From year 1743 until year 1822

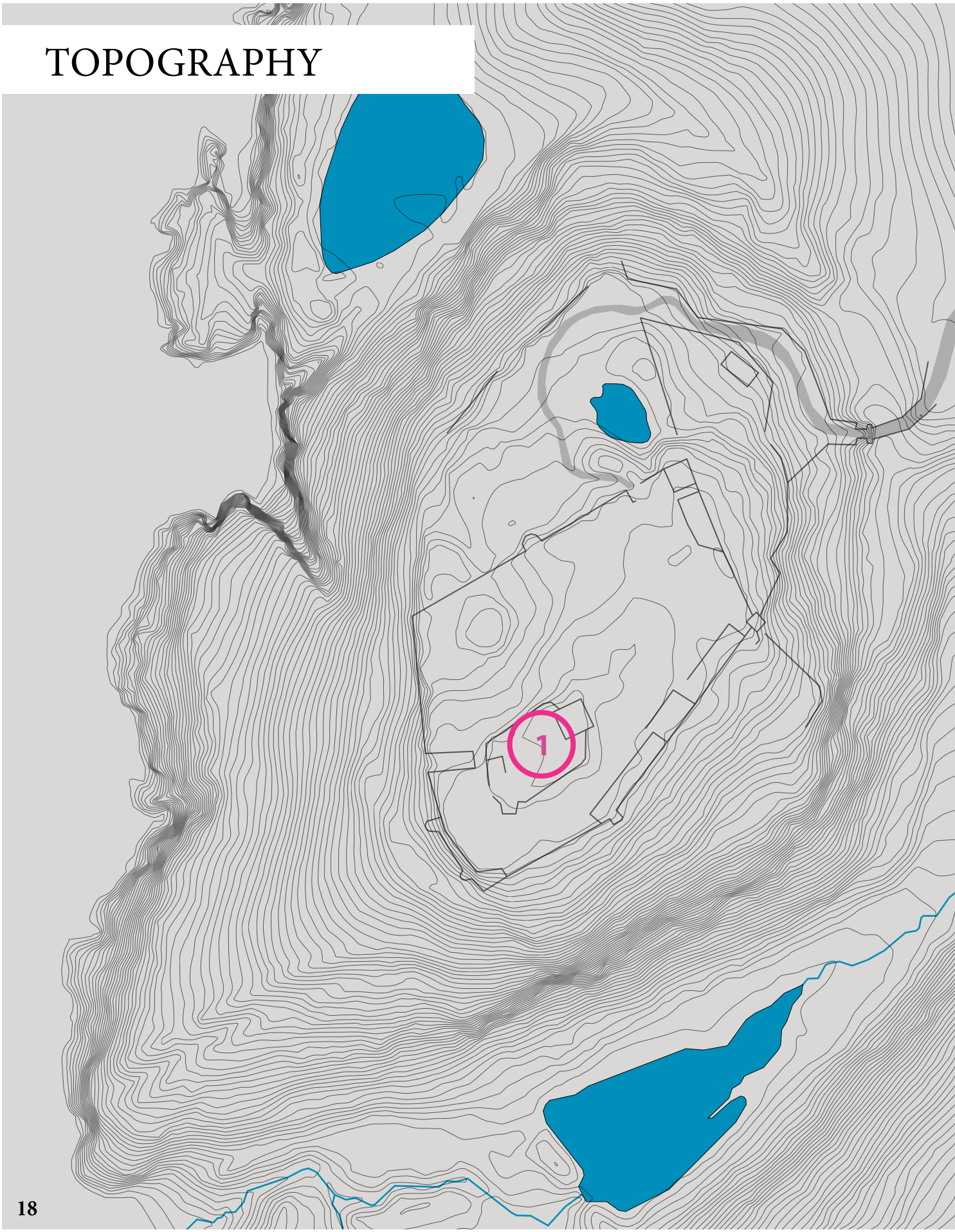
5. Period from preservation to now. From year 1822 until today

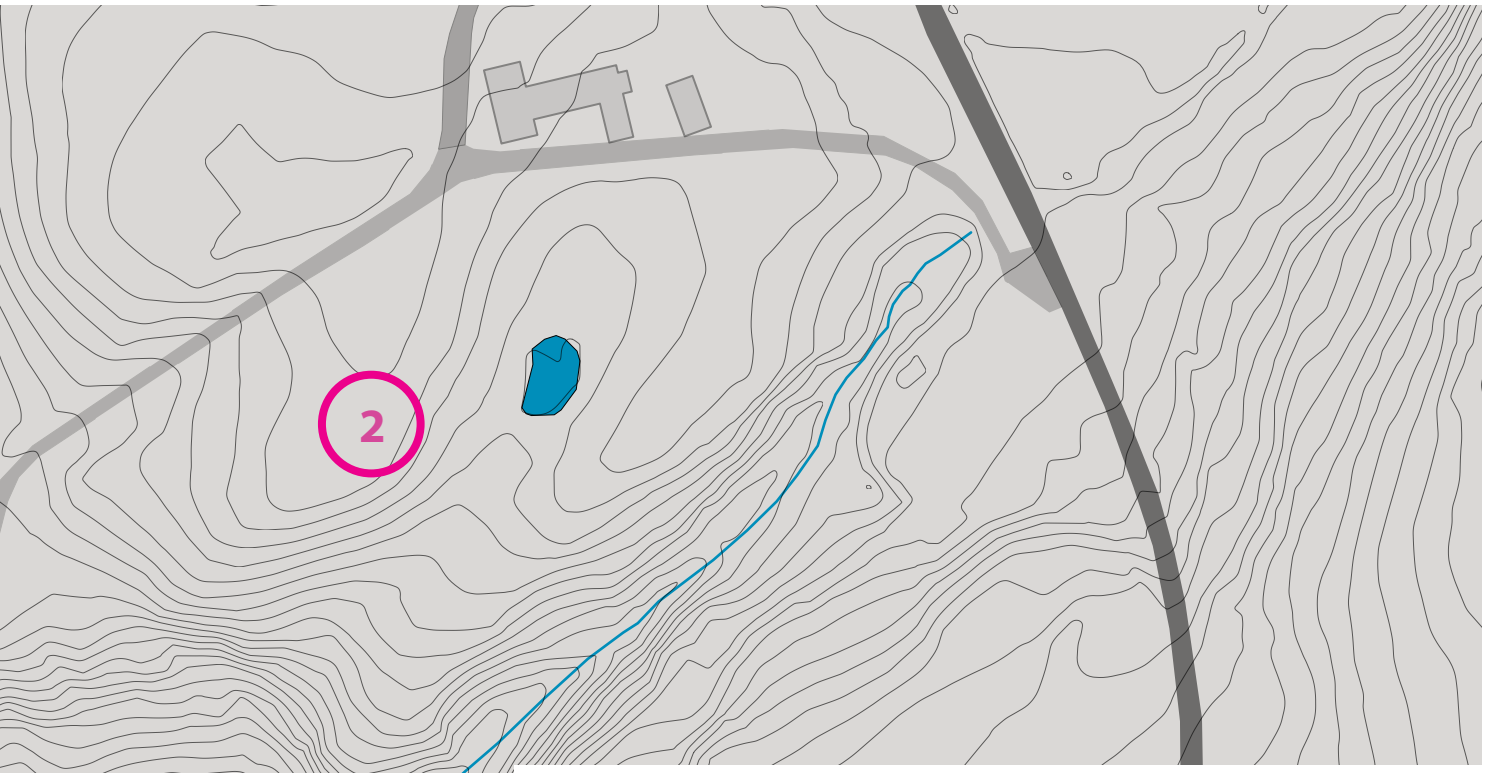
In creation of the new visitor centre there should therefor be made room to communicate the story of all five periods.

Ill 7: The added halt-round towers.

Ill 8: Hammershus as it assumed to look like before it was abonded.

TOPOGRAPHY





An investigation of the topography can help to understand the landscape and how it was used in the making of Hammershus. The way the landscape was used can therefore help to define, how the landscape should be used in developing the new visitor centre at Hammershus. So that the coming visitor centre will live up to the competition demands.

Topography of the landscape

The topography is at the site very rough. The ground rises from sea level to a height of 74 metres at the highest point inside ruin. In general the plateau where the ruin is build is raised on a solitary hill. North-east of the ruin is a big green field, which today is experienced as a flat ground. This area is placed 55 meters above sea level. It is in this area the visitors arrive today. South and southeast of the ruin is a small gorge called Mølledalen. Mølledalen rises from sea level in southwest to the same level as the green field in northeast.

The ruin vs. the topography

Hammershus is carefully placed on top of the plateau and following the existing topography on the site. The precastle wall is to the north placed exactly where the steep inclination stops. To the west there is no precastle wall only the inner wall placed in the same way as to the north exactly where inclination stops. Against east the inner wall is placed where inclination stops and the precastle wall is placed on the steepest place. This also counts the southern inner and precastle walls. In this way it was made more difficult for enemies to conquer Hammershus. Inside the inner walls is placed a small hill, and on this hill is the most important building of the castle Mantelgården placed. This both marks the hierarchy of the castle, and gives the tower of Mantelgården a better overview to the areas surrounding Hammershus.

The green field (2) is also believed to be the main area, where enenys did settle down, when they did conquer the castle by siege. (Bjerregaard, 2013)

Summery

If the new visitor centre should fit in to the surroundings at the ruin it is therefore important to place the centre with same carefulness in to the landscape. The placement is also very important in proportion to the hierarchy. If the centre should fit in to and not overtake the hierarchy it is therefore important that, Mantelgården still is the highest building.

1: Hammershus ruin 74 meters above sea level.
2: Green field 55 meters above sea level.

Ill. 9: Hammershus

INFRASTRUCTURE AT HAMMERSHUS

For having a better knowledge about how the tourist arrive at Hammershus, what they experience when arriving, and therefore what to underline in the new visitor centre the infrastructure has been mapped.

Hammershus is placed on the north-westerly part of Bornholm close to Sandvig and Allinge. It is possible to arrive at Hammershus in different ways.
After arriving at Bornholm by either ferry or plane. Arrival to Hammershus can either be done by car, bus, foot or bike.

By arrival the tourists are directed from the parking areas for bikes and cars in east (1a) or the bus area also in the east (1b). From there visitors walk to the present visitor centre (2) and further on over a small hill to the bridge (3). The road from the parking areas passing the the present visitor centre towards the bridge and all the way to the castle is one of Denmarks oldest medieval roads. Due to defenceive reasons the road is turning, so that it is more defficault to attack the castle. The bridge (3) is also the original arrival point for Hammershus castle and marks at the same time the entrance to where the actual buildings of the ruin begin. Despite that this route marks the original arrival it also gives an overview of the ruin.
(Miljøministeriet, 2007: 2-10)

From the bridge the path leads up to a natural view point (4) from where tourists can get a clear view of the harbour of Hammer. After the view tourists enter the inner courtyard (5). The hierachy of the inner courtyard is described in the next paragraph: The Hammershus Ruin.
With the knowledge of tourists arrival route, it would be natural to place the new visitor centre along that route, so that they will get a natural contact with the new visitor centre.

Ill. 11: View

Ill. 10: Mantelgården

1a - Parking area for cars and bikes
1b - Arrival by bus
2 - Exist,ing visitor centre
3 - Bridge for entering Hammershus
4 - Natural viewpoint
5 - Inner courtyard

Ill. 12: The original bridge

Ill. 13: View from parking towards Hammershus. The existing restaurant and museum seen on the right.

500 m
450 m
400 m
350 m
300 m
250 m
200 m
150 m
100 m
50 m
1a
2
1b
4
3
5

Ill. 14: Area around Hammershus

A BIRD'S EYE VIEW OF HAMMERSHUS

The bird's eye view shows ruin as it is today. The picture should create an overview to the ruin before more specific details are analysed.

On the picture the half-rounded towers build by the Lübechs in the walls of Mantelgården and in the walls surrounding the inner courtyard is visible.

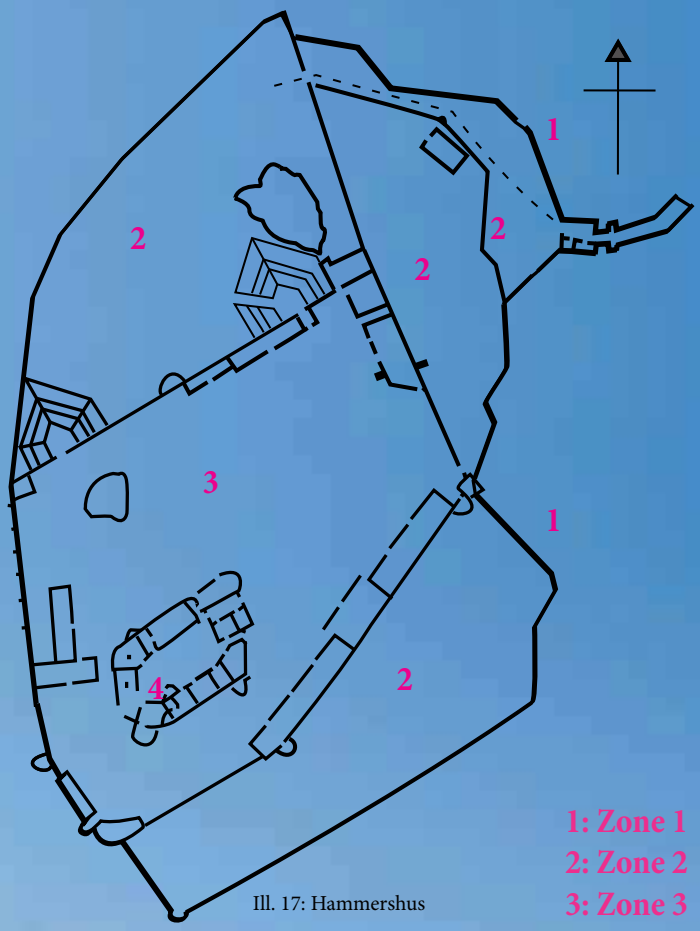
On the picture it is clear to see that Mantelgården stands out as the natural centre of Hammershus.

Ill. 15: Bird's eye view

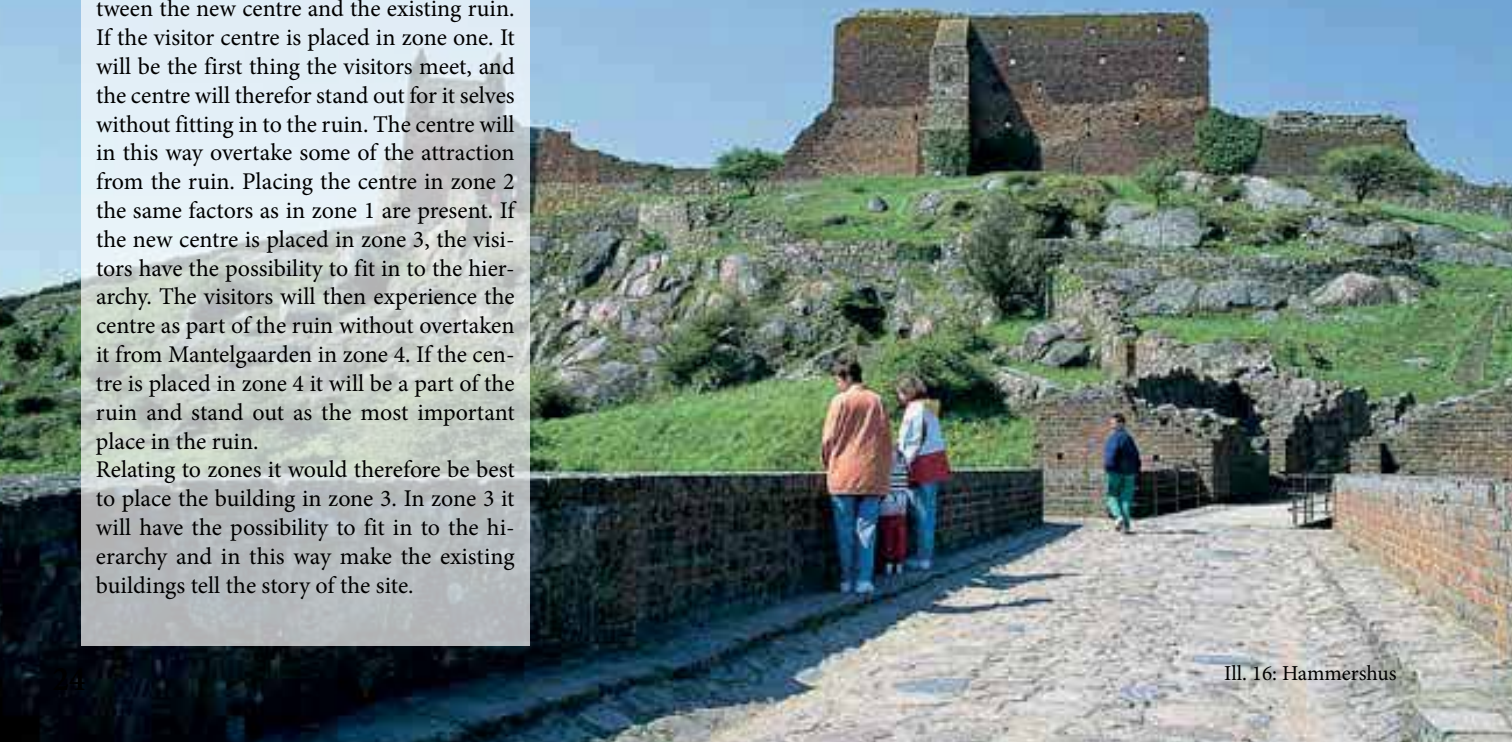
THE HAMMERSHUS RUIN

Hammershus ruin is divided into four different zones. **Zone 1** is the outer zone, where the external defences was placed. The external defences were given from nature by the impassable hill. **Zone 2** is between the precastle walls and the inner walls. It is placed just before the drop in the terrain to give the best overview to the surrounding areas. Around year 1600 the precastle walls were given up. **Zone 3** is the inner courtyard. **Zone 4** is the natural centre of the ruin; it is the area around and inside Mantelgården. The reason that Mantelgården turns out to be the natural centre for the ruin, is as I see it due to three factors: 1: The placement on the hill as described in the paragraph Topography. 2: It's placement in the centre with free access all way around. 3: Mantelgården's buildings especially the tower, which is the highest point at the ruin. When Mantelgården is the natural centre it means that every visitor will at some point visit and see that building/area, when they visit Hammershus. The importance of Mantelgården can also be seen in the thickness of the walls, where Mantelgården at someplace has a thickness of more than 2 metres. The average thickness of the walls is between 0,8 metre and 1 metre (Miljøministeriet, 2007:10 &14).

When placing the new centre at Hammershus the zones play a role in hierarchy between the new centre and the existing ruin. If the visitor centre is placed in zone one. It will be the first thing the visitors meet, and the centre will therefor stand out for it selves without fitting in to the ruin. The centre will in this way overtake some of the attraction from the ruin. Placing the centre in zone 2 the same factors as in zone 1 are present. If the new centre is placed in zone 3, the visitors have the possibility to fit in to the hierarchy. The visitors will then experience the centre as part of the ruin without overtaken it from Mantelgaarden in zone 4. If the centre is placed in zone 4 it will be a part of the ruin and stand out as the most important place in the ruin.
Relating to zones it would therefore be best to place the building in zone 3. In zone 3 it will have the possibility to fit in to the hierarchy and in this way make the existing buildings tell the story of the site.

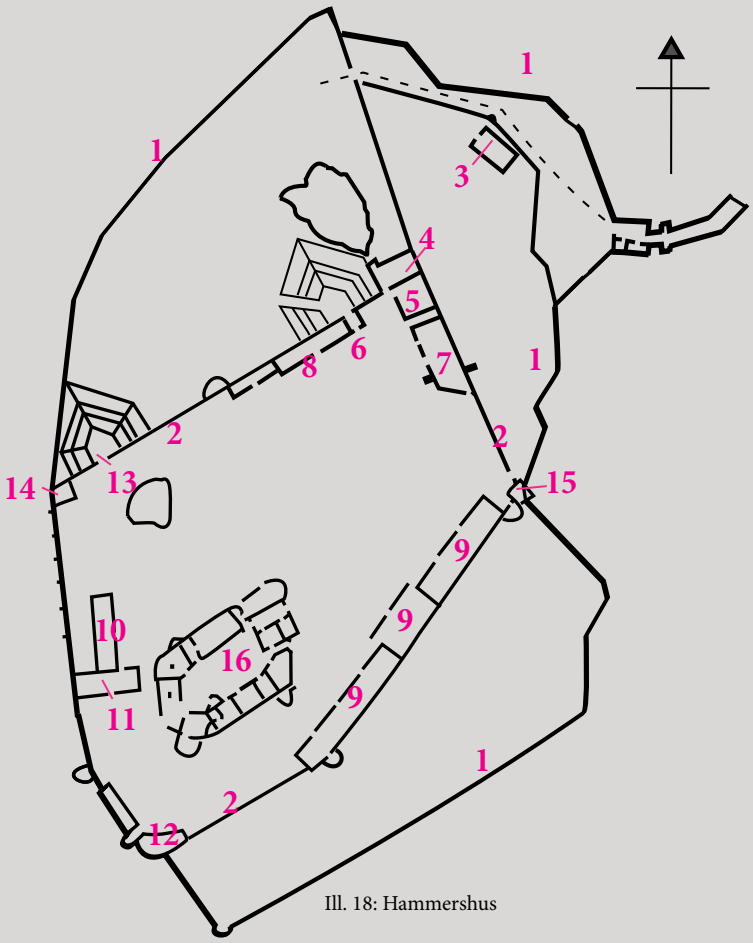


Ill. 17: Hammershus



Ill. 16: Hammershus

BUILDINGS IN THE HAMMERSHUS RUIN

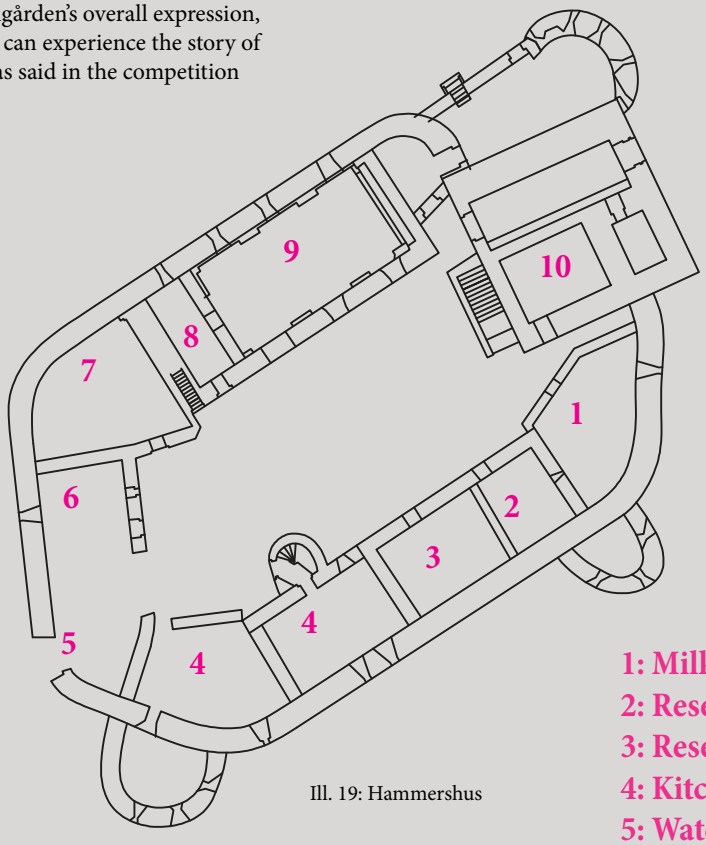


Ill. 18: Hammershus

1: The outer castle wall
2: The inner castle wall
3: Court building (Tinghus)
4: The new cellar for butter
5: The old cellar for butter with a battery on top
6: The main gate
7: The big warehouse for storing taxes and fees
8: Stable for riding horses
9: Stables for draugth horses and warehouse
10: Living house for vice commander and artillery
11: Scullery containing brewery, bakery and more.
12: The fox tower, build by the Lübecks and containing a battery. It is build on top of an old entrance, the sea gate.
13: The Swedish hole, the rumours says that the swedish did force their way in here in the capture in 1645.
14: Dog tower, served both as a prison tower and defence.
15: Blommetårnet, used for prisoners and the best preserved building.
16: Mantelgården, see details on following page.

MANTELGÅRDEN IN DETAILS

Underneath is a detailed scheme that tells which type of rooms Mantelgården did contain, and where they were placed. The type of rooms such as the chapel and the king's private champers do also underline that Mantelgården was the most important building at Hammershus. In a storytelling perspective it is therefore important to keep Mantelgården's overall expression, so that visitors can experience the story of Hammershus as said in the competition demands.



Ill. 19: Hammershus

1: Milk room
2: Reserves
3: Reserves
4: Kitchen
5: Watergate
6: The big kitchen with living area on top
7: Castle room, living area for serving personal
8: Hallway for church
9: Chapel with the kings private chambers on first floor.
10: Manteltower, containing:
- **Administration of the island**
- **Representative offices**
- **Living Area**
- **Prison**
- **Storage**

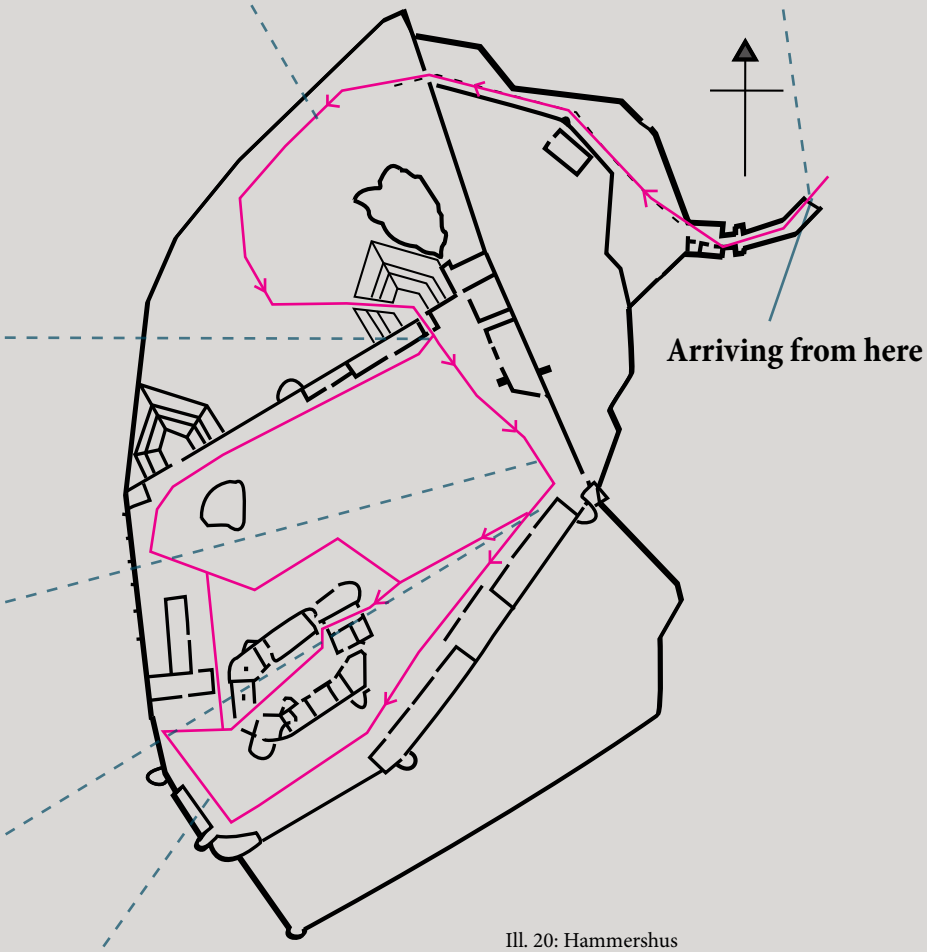
FLOW DIAGRAM

The pink line marks the main route inside the ruin of Hammershus. That is the route that most visitors are disposed to choose in their way around the ruin.
The mapping of the route is based on an interview with the nature guide at Hammershus, and my observations of visitors of Hammershus.

If the new visitor centre should be a natural part of the ruin it should therefore be placed close to the flow. At the same time if the visitor centre should help the tourists understand and experience the ruin it should be placed early on the route of flow.

At this point many arriving visitors stop at the benches and enjoy the view. The main part of the arriving visitors follows the road to the main entrance, with visitors leaving the ruin having a bigger tendency to walk outside the path.

Allmost every tourist arrives from the parking area by the original medieval road crossing the bridge. Only a few percent arrive from walking paths at the seaside.



Ill. 20: Hammershus

From the main gate visitors continue straight forward. The mainly reason is the buildings on the left dragging people, and the topography forming a natural path.

Here many visitors take a view towards the parking area in the east before continuing on the natural path.

From here the visitors are natural divided in to three groups. One group walks into the stables against south. A second group follows the path straightforward and walks between the southern inner wall and Mantelgården. The third group walks to the tower of Mantelgården.

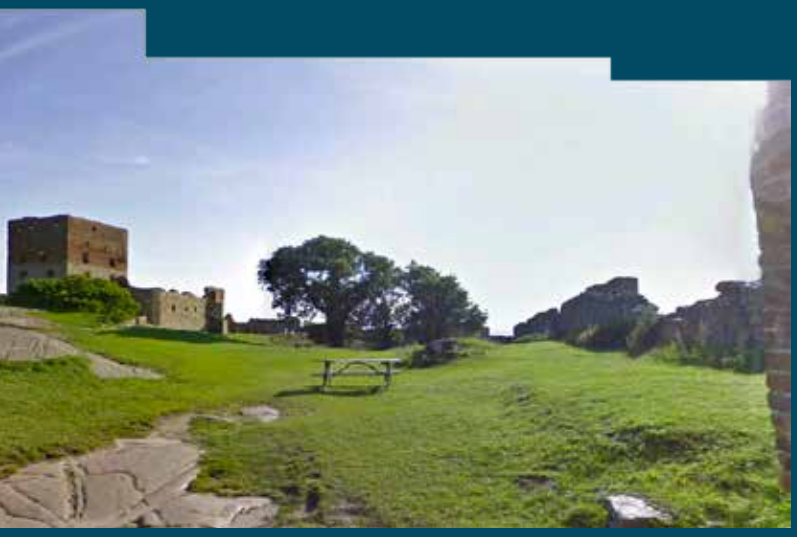
Visitors will at this point walk to Mantelgården, if they haven't been there. If they arrive from inside Mantelgården, they will walk to this point, due to the stunning view.

Ill. 21: Panorama 1 - The Inner Castle Yard

Ill. 21: Panorama 2 - Mantelgården

Ill. 22: Panorama 3 - Mantelgården

PANORAMA PHOTOS

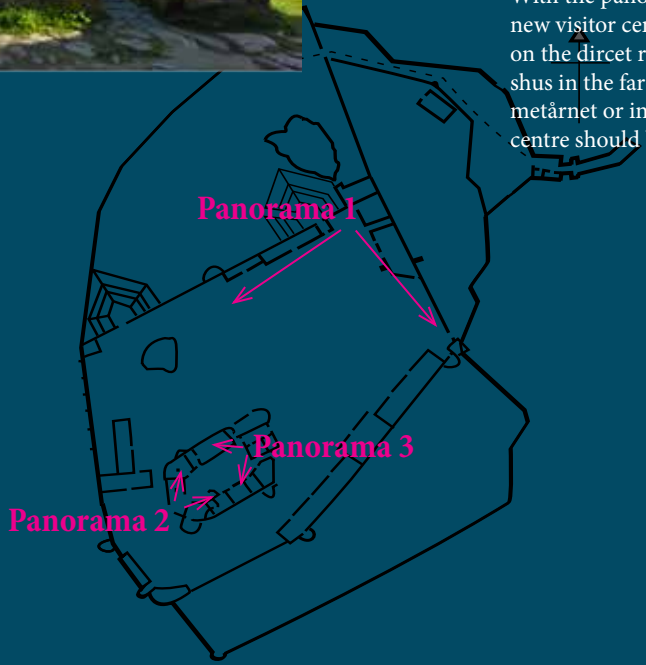


The panorama photos help to define the experience that visitors will get, when arriving at Hammerhus, and can therefore help defining the site for the new visitor centre.

Illustration 15 shows the visitors view arriving to the inner court. From the viewpoint it is clear that Mantelgården stand out as the central area in the ruin, this because the location in the centre of the ruin, and because the ground is rising itself a bit towards Mantelgården. At the same time it is clear to see that most visitors continue by the path on the left side past the big warehouse.

Illustration 16 and 17 visualise the feeling of being inside the ruin of Mantelgården. From the centre spot Mantelgården appears today very closed and orientated inwards to itself. The remaining outer wall of Mantelgaard has heights between 4 and 9 metres, so when visitors stand inside Mantelgården it is almost impossible for them to look out in the surrounding landscape. Only through the entrance seen on illustration 17 it is possible to get a small view to the surrounding area. This orientation inwards gives the tourists a feeling of being lonely, and the people inside Mantelgården would not register the visitors outside Mantelgården in the inner courtyard.

With the panorama pictures in mind the new visitor centre should be placed either on the dircet right after entering Hammershus in the far east corner next to Blommetårnet or in Mantelgården if the visiter centre should be seen by arrival.



Ill. 21. Panorama overview

AUDIENCE AND OPENING HOURS

The target audience for the new visitor centre is defined by the people already visiting Hammershus and by the spatial program. The target audience includes therefore families, couples and singles visiting Hammershus as tourists, people with interest in the unique nature at the site and school classes. They all have in common the fact that they will only visit Hammershus in the tourist season from May until October. In addition to the tourists a number of local people and walkers will visit Hammershus all year (Bjerregaard, 2013).

This means that the opening period for the new visitor centre is from May to October, but because of the fact that the ruin is visited all year it should always be accessible to the public, and there should be a possibility for visitors to seek shelter and have access to toilets. The shortened opening period also have a positive effect on the energy use, because the building dosn't have to warm up to comfortable temperatures in winter period.

Ill. 23: Tower - Mantelgården

SPATIAL PROGRAM

In the following text a description of the diferent functions that will be a part of the new visitor centre is made. This description is based on the program for the competition (Naturstyrelsen, 2013:16-17), interview with employees (Bjerregård, 2013) at Hammershus and own observations.
The following descriptions include an explanation of the existing conditions, and future needs and wishes.

Exhibition area

The exhibition area will be used to introduce the visitors to the past of Hammershus.
This area has to allow installations of the newest technology meaning that the exhibition is thought to also contain digital material though this isn't specified further.
Including in the exhibition is a need for a reception and a place to sell tickets.

Classrooms

School classes is often visiting the ruin where schoolchildren will get an introduction to the history of Hammershus.
Therefor two classrooms with space for 30 persons each are needed. The two classrooms should have the potential to be made in to one room, so that the room can be used for conference.
In the inverview Bjerregaard did express a wish to have direct view to the ruin from the classroom, so that showing the ruin and not only the pictures can done during the teaching lessons.

Restaurant/cafe

In relation to the new visitor centre a space for up to approximately 150 guests is required. Together with the restaurant is also the need of a kitchen area, changing room for staff and storage for food.
From the restaurant it should also be possible to serve the classroom area.
Leasing the café is planned. The café should therefore have possibility to open outside the exhibition area's opening hours.

Practical issues

Hammershus is as earlier mentioned a popular place to visit with up to 400.000 tourists a year. Therefore the practical functions are essential to ensure a better visit.
These functions will for instance be toilets, rooms for storage/wardrobe, technical area, storage room, entrance and a space to shelter for the passing rain. Last mentioned can be an outdoor area also used as meeting point. In the programs a need for toilets open outside opening hours are expressed.

Function	Area	Time of use
Exhibition area	290 m2	10:00-18:00
Classroom	380 m2	8:00-16:00
Restaurant/cafe	380 m2	11:00-21:00
Practical issues	250 m2	08:00-18:00

WEATHER PARAMETERS

Sun

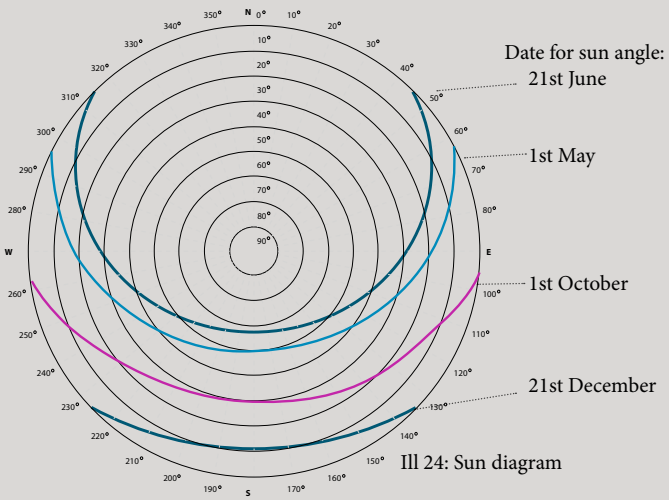
The average yearly sun hours for Denmark as a whole is 1495 hours, but it varies from year to year. On Bornholm the normal yearly sun hours are approximately 1600 hours, a fact that underlines Bornholm's brand as The Sunny Island. (DMI, 2013a)
Looking at the sun chart it can be seen, that the angle from where the sun rises to where it sets changes remarkable throughout the season from may to October where the visitor centre should is open. In the most visited period from June to July it is important to notice that the sun sets in northwest. It is therefor necessary to orientate the new visitor centre in that direction if a sunset should be seen.

Rain

The annual rainfall every year is a average of 760 mm. of water for Bornholm. For the rest of Denmark the average annual rainfall is 712 mm. For the time of year when Hammershus is visited the average number of rainy days is between 7 and 10 days a month. (DMI, 2013b)
With approximately 10 rainy days a month it is important to make an area, where the tourists can seek cover for the temporary showers.

Temperature

With daily outdoor temperatures in the opening period that varies between 13 degrees in April as the lowest temperature and 22 in July as the highest temperature, the visitors will therefor both be wearing summer clothing as shorts and t-shirts and more warm clothing in spring and fall. The indoor climate in the visitor centre has to reflect that.
As seen on the weather diagram the night temperature will in wintertime be below freezing or very close to freezing temperatures. This should be noticed so that frost in the exhibition will be avoided.



Ill 24: Sun diagram

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Otc	Nov	Dec
Rain (mm)	59	53	62	53	62	74	71	66	57	61	69	73
Rainy days	13	10	12	11	11	11	10	10	9	9	12	13
Day temp.	4	6	9	13	17	20	22	22	19	15	9	5
Night temp.	-1	0	2	4	8	11	12	12	10	7	3	0
Sun hours	42	71	98	141	187	176	183	175	134	108	58	38

Ill 25: Weather diagram

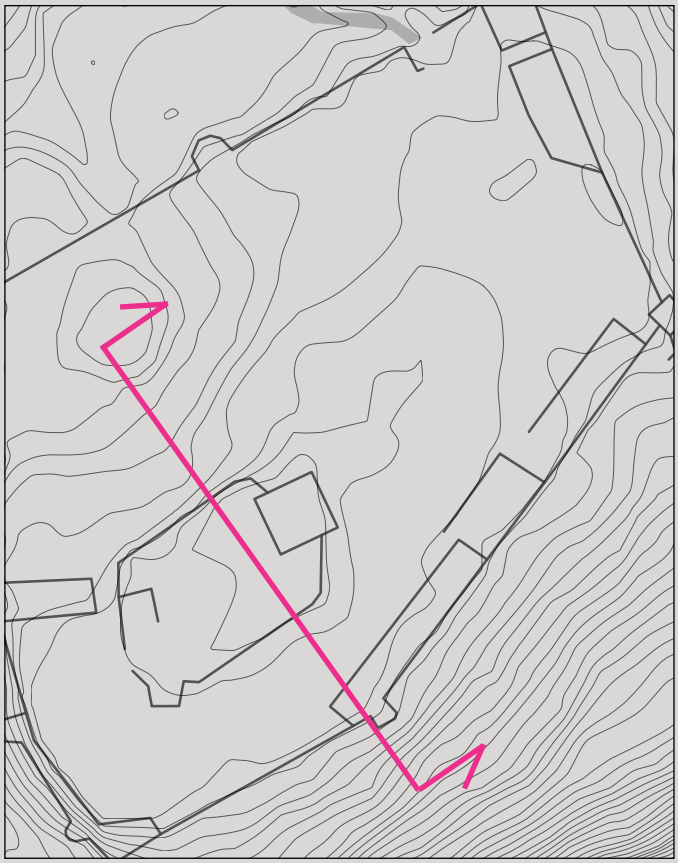
SECTION AND HEIGHTS OF AND IN MANTELGÅRDEN

Illustration 26 shows a section of Mantelgården and Hammershus inner courtyard. The section is used to give a better understanding of the Hammershus area.

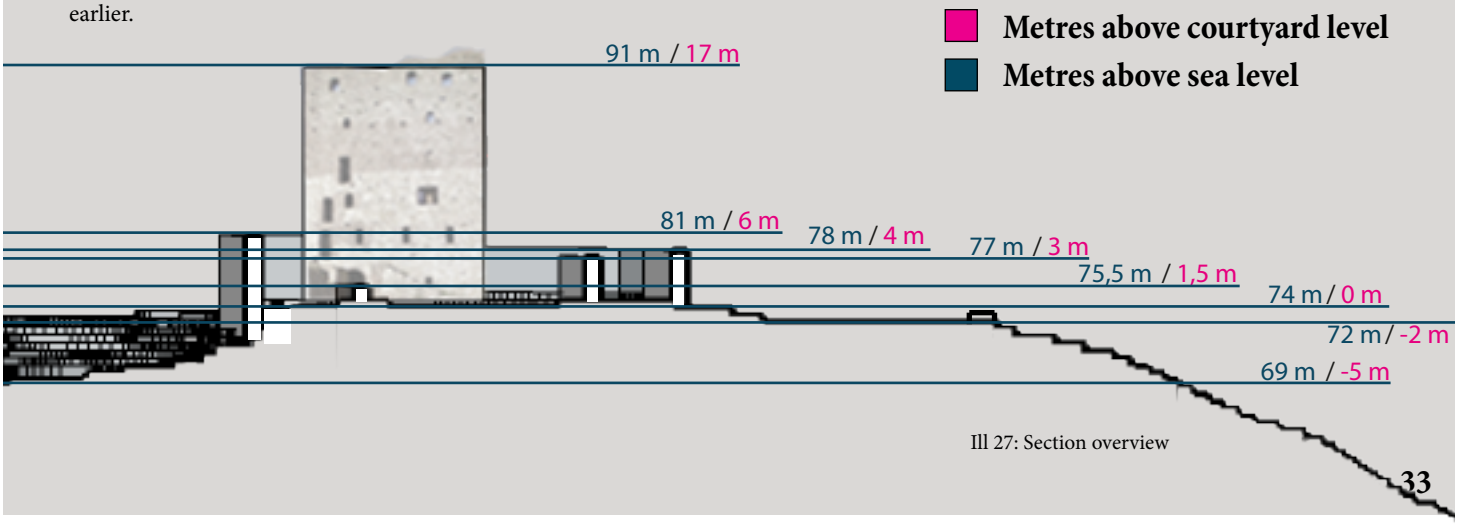
The heights in the existing ruin of Mantelgården reaches up to 17 metres above Mantelgården's courtyard level. This is the tower of Mantelgården. The wall heights in Mantelgården vary between 6 metres in general, and up to 9 metres in a small part for the northern outer wall. The southern outer wall varies between 4 metres and 6 metres above courtyard level.
The northern inner wall reaches 1,5 metres above courtyard level. The southern inner wall reaches 3 metres above inner courtyard level. The inner castle wall to the south is one metre high. For the inner walls to the east, west and north, which is not seen on the illustration, they vary between one and three metres in height. And in all walls there are pieces, where the walls go down to a height of one metre, so visitors can have a look outside the ruin. From inside Mantelgården it is not possible to look out, due to the high walls. Instead visitors enter to a kind of pupa.

If a new section perpendicular to the section on illustration 26 were made, the section would tell the same story of Mantelgården as a closed pupa on top of the hill, therefore only on section is made. But on the following pages a map defining wall heights of the remaining walls of Mantelgården is made.

On the section it is also possible to see the hierachy within the ruin as described earlier.



Ill 26: Section overview



Ill 27: Section overview

WALL HEIGTHS AT HAMMERSHUS

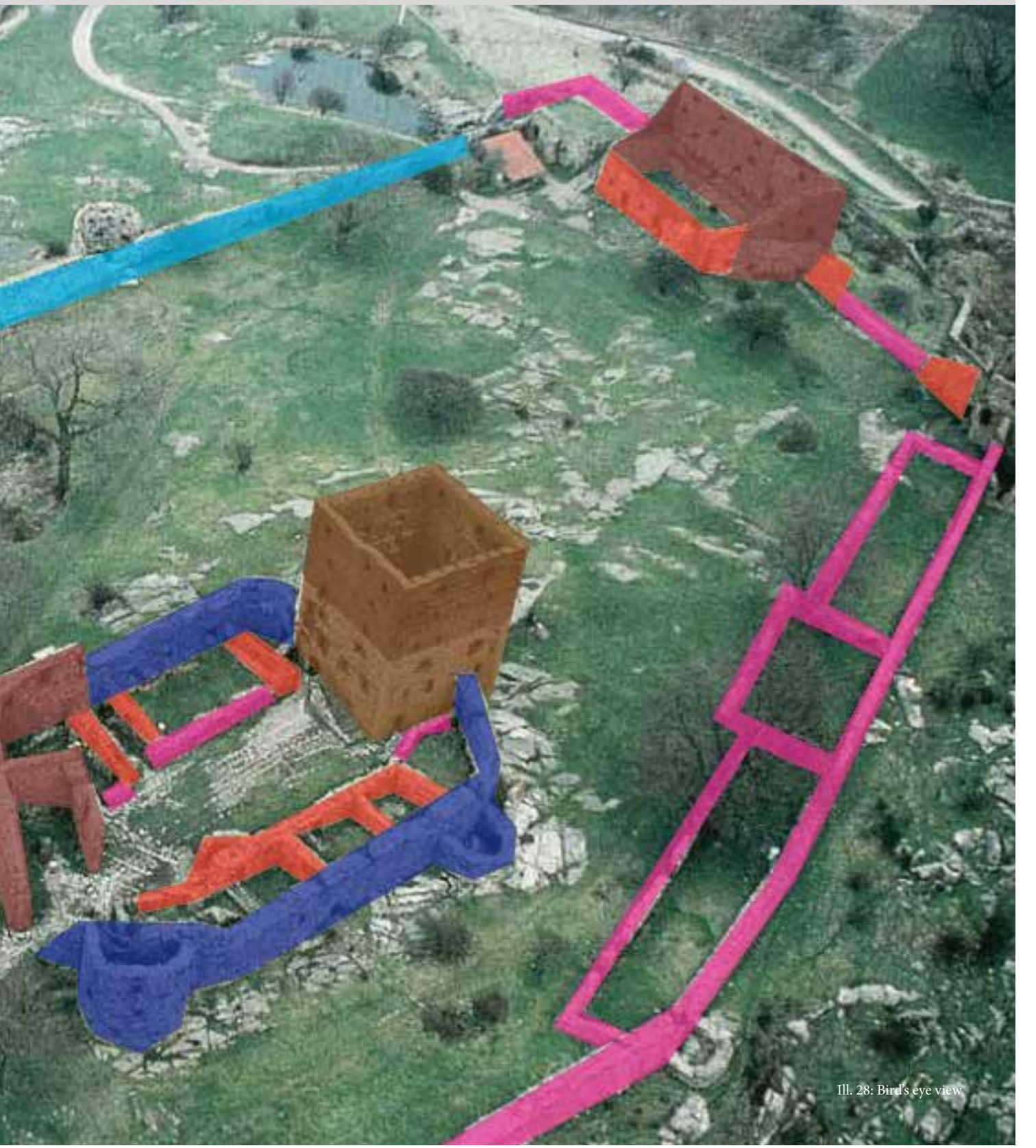
This illustration is a continuation of the section. The illustration shows the different wall heights of the walls at Hammershus. This is done to investigate, where it is possible for visitors to have a look outside the ruin, and where the visitors will step into a kind of pupa or only can orientate towards inside the ruin and not outside the ruin. In general it can be said, that wall heights above 1,75 metre doesn't allow the visitors to have a look past the given wall.

With this knowledge it is possible to see that Mantelgården has the possibility to create a room where the visitors can concentrate on the exhibition without getting disturbed by other tourist. At the same time Mantelgården has the limitation, that it doesn't allow views to surrounding areas without removing parts of the original wall. Mantelgården does also have many small walls that use define rooms, these walls will therefore complicate the new room program.

On the illustration it can be seen, that the stables to east marks an area, but does still allow view towards and away from the area. If building on the stables it would therefore be possible to create views where it is wanted. The stable is also a big open area without many remaining walls to complicate the room program. From a height point of view the stables will therefore give the possibility for creating a new visitor centre more freely without limiting walls.

Wall Heights:

- **Below 1,5 metres**
- **1,5 - 3 metres**
- **3 - 4 metres**
- **4 - 6 metres**
- **6 - 9 metres**
- **17 metres**



Ill. 28: Bird's eye view

NATURE AND VEGETATION

Hammershus is placed outermost on a natural protrusion surrounded by The Baltic Sea to the west, a gorge to the south and a stony beach to the north. This all makes Hammershus appear as a rugged and reclusive area. To the east a flat green area surrounds the ruin. This area does by itself welcome and invite to picnic. But because it neighbour the rock, it underlines the impression of a rugged and reclusive area. This is also underlined by the small, and from long distance not visible, gorge. At the gorge the earlier described bridge connect and underline two different kinds of the nature experiences within the area.

The earlier described bridge also underlines the different vegetation and different experience in the two areas. The flat area is covered by low vegetation, be it different types of grass and small bushes. The same low vegetation covers the ruin area on the other side of the bridge, but in that area the rock also gets visible. This exposure makes the area appear more rugged. The small bushes in the ruin area are also dominated by yew, which do not appear very welcome due to its needles.

From the top of the rock, there is a magnificent view to all corners of world, and from there the different kind of nature to each direction is even clearer.

The nature at Hammershus has changed its characteristics several times. Original there was a lot of high trees in the area, this also includes the now a days bare flat and hilly area. When Hammershus was build many trees in the nearby surroundings were used for the construction, and the area ended up flat and bare. Later when the castle was abandoned the trees grew up again. These trees are now removed, because Naturstyrelsen wants an area that reflects the days of glory at the ruin. At the same time Hammershus today is turned into a centre for different small plants among them also preserved types. The hill facing south is for instance one of the places in Denmark with most different types of vegetation. This is because the orientation towards the sun and because the hill has newer been used for agricultural purpose. On this specific hill exists a variation of more than 300 different types of plants. (Bjerregaard, 2013)

With a nature as described underlining the rugged and reclusive impression of Hammershus the new visitor centre should allow the visitors view to the magnificent nature. Especially the story about the hill facing south should be told.

Ill. 29: The western seaside

Ill. 30: The flat green area to the east

Ill. 31: View from Hammershus to the south

Ill. 32: View from Hammershus to west

Ill. 33: Preserved plant growing in the wall

Ill. 34: The bridge between the flat green area and the rock.

PROGRAM SUB-CONCLUSION
- Choice of site

The previous paragraphs have described Hammershus, Mantelgården and the area around it. With an overall demand from the developer of having focus on presentation and communication of the ruin (page 14), the new visitor centre has to fit in to the hierarchy within the castle, so that the ruin still is the most important at the site. The topography (page 18) clearly shows that Mantelgården highest in that hierarchy the buildings within. Looking at the rooms that Mantelgården did consist of, the Kings chamber and so on (page 26), it is also clear that Mantelgården was the most important building. Placing the new visitor in Mantelgården would therefore make the new visitor centre a natural centre for the tourists, but with a risk of overtaking the hierarchy. Investigating the zones at Hammershus (page 24) the conclusion was, that the visitor centre would be better placed in zone three, because that would keep Mantelgården as a natural centre of the ruin. Within zone three the site should be a place that people natural pass by, from the flow diagram (page 27) it can be seen that the stables to the south fulfil that demand. The stables to south will also be seen when entering the courtyard (page 28-29). By placing the visitor centre in the stables to the south it will also open up the possibility to tell the story about the preserved slope just south of the stables.
Due to the height in Mantelgården the Stables are also a better place. They will allow the new visitor centre to create focus in exactly the direction that is wished without breaking down any existing walls.

When arriving many tourists would also like an overview of all Hammershus and its surroundings. To get that a tower could be created in the stables, but it would make Mantelgården loose its spot on top of the hierarchy. The best place to create that viewpoint would therefore be at the top of the Tower in Mantelgården.

By placing the site within the ruin of Mantelgården a new problem occur. Only a small bridge lead up to the ruin, and only special trucks can go there a place to drop of cargo for the visitor centre is needed.

So for the new visitor centre should be able to tell the story about Hammershus as a key point in the History of Bornholm, about the fights the that have taken place at the castle and about the nature that surrounds Hammershus the new visitor centre will be divided in to three pieces in three different sites. The three sites have all in common that they are placed, so that the majority of all visitors according to the flow diagram will pass by, and therefore have the possibility to visit them.

Site one should be at arrival. Here can be placed the basic information's that is needed at this point, and at the same time some practical installations could be placed here. From a historic point of view this site was here the different enemies of different time periods did attack from, and is was also here the farmers did arrive when they should visit the castle. So from here visitors can have the same view on Hammershus as enemies and farmers had. This also the place where cargos for the visitor centre can be dropped.

Site two is the overview of the ruin and the landscape surrounding it. It is the top of the tower. The tower is the natural attraction for many visitors. Here they can overlook the whole complex, and from the tower it will be possible to scout for enemies. Site two will only consist of a platform from where tourists can enjoy the view.

Site three will be the main part of the new visitor centre, and it will be here, the focus of the project is placed. This site is chosen to be the old stables. The research of the flow shows that the majority of the tourists visiting pass the stables, and no one will therefore miss or overlook this part of the visitor centre. At the same time the stables are placed in the back end of the courtyard from where tourists enter, this means that a building here will not stand out for it selves, but more fit in to a total experience of Hammershus. The stables also have the advantage to only be marked by the remaining walls today. This means, that only outer lines of the walls are left, and the building at this site allow view in all directions. The new visitor centre here should be as a part of the ruin without overtaken it. This means on one hand it has to fall in to the hierarchy of the ruin, so that tourists still will experience Mantelgården, the outer and inner courtyards and the nature as more important places, on the other hand it shouldn't be overlooked. This building should contain exhibition, restaurant, school classes and practical rooms.

With sites as number 2 and 3 chosen, there will be various challenges related to these exact spots. This concerns the transformation from ruin to visitor centre, the clash between the original walls of the ruin and the new walls in the new visitor centre, the stability of the ruin and the conservation of the area. In this project I will leave out of account the last two. The transformation and the clash will in the followings paragraphs together with other exhibition centres be analysed.

Ill 35: Site

IMMEDIATE SURROUNDINGS

To give a better understanding of the three chosen sites, this paragraph will describe the nearby surroundings surrounding every site. This will help to find out, if any special considerations should be taken in to the design process.

Site one is, as seen on previous page, surrounded by an open area an the immediate surroundings are therefor the flat green fields. Due to the open area existing ruins do therefore not decide an approximately square metre amount.

Site two is on top of the tower.
From here there is a clear view to all the surrounding areas.

Due to the proportions this report will only concentrate on making a visitor centre on site 3. Site 1 and 2 will therefor not be mentioned more.

The immediate surroundings of site two is to the south and southeast the sunny cliff side which is overgrown with preserved plants. The cliff side starts to decrease directly on the outer side of the wall. To the east Blommetårnet is placed, the best preserved building on the site. Blommetårnet is 8 metres high to the edge of roof and approximately 11 metres to the ridge. To the north the inner courtyard is placed, and consists of an open flat area. To the northwest is Mantelgården. At the shortest distance the distance between Mantelgården and the stables is 12 metres. From the middle of the site there is approximately 30 metres to the entrance to Mantelgården through the tower. To the west the open area of the courtyard continues until the watchtower in the corner of the ruin.

The approximately square metre amount of site two can be seen on the picture on this page.

With site two bordering to Blommetårnet to the east it is therefore important to investigate how high the new visitor centre can be without disturbing the hierarchy. To the south a view to the nature will be natural to implement. With Mantelgården placed only twelve meters away it would also be relevant to look into possible shadows from there.


Site 2
Site 3
9,3 m
28,5 m
263 m²
70 m
11,5 m
20 m
186 m²
11,2 m
8 m
258 m²
41,5 m
18,6 m
4,3 m
5 m

Ill 36: Site

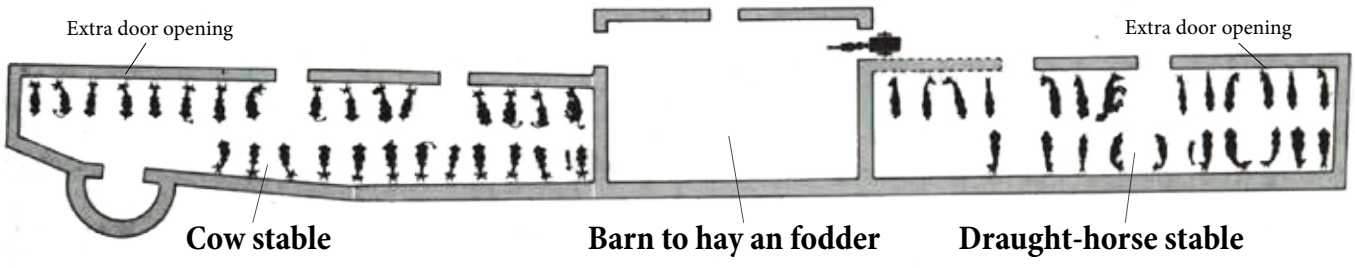
THE STABLES

The stable consists of three parts. The middle part was a barn in which storage of hay and fodder was done. It was a farmland barn in which the packed carts could drive in in the one end and then unburden the carts in the middle before driving out in the other end. The half-rounded tower in the one end build by the Lübechs is called Koborrerundellen probable because it is placed next to the stable for cows. Today the half-rounded tower is more or less gone. The other stable is believed to be a stable for draught-horses. (Miljøministeriet, 1991:18)

In general the heights of the remaining ruin vary between 1 metre at the lowest point and up till 2 metres on a specific point. As earlier described do the wall thickness change from one metre in the outer wall and to 60 centimetres in the inner walls. Due to the fear of attacks the outer walls are thicker.

Comparing the ruin at Hammershus with the drawing underneath there is today a bit difference. Instead of only two door openings in each stable like the drawing shows, there are actually three door openings in each stable. The extra door openings are also marked on the drawing.

Ill 37: Picture inside site number two



Ill 38: Site number two

SUBSTANTIAL CHARACTERISTICS

With Hammershus as a medieval castle specific characteristics appear. These characteristics have I chosen to include in to the new visitor centre.

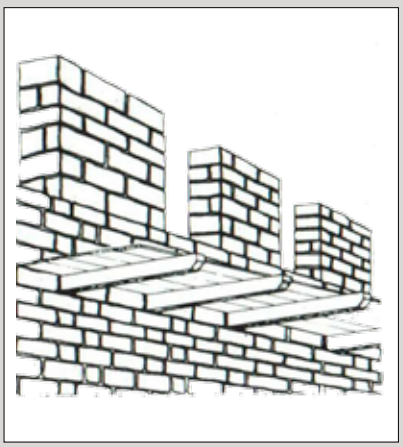
In the Manteltower a **special kind of windows** was made. These windows include a place to sit. This was done, because the building in general was hard to get heated up, and the king could therefore sit in the window, and let the sun do the heating. (Bjerregård, 2013)

The watchman path was made, so it was possible to keep an eye on possible enemies arriving. It was made, by incorporating wooden beams in to the outer walls.

Despite the watchman path many **portholes** was made at Hammershus. These portholes appear in many sizes.

In general for Hammershus complex and Mantelgården in particular there is an **introvert orientation**, here by means introvert towards the courtyard. This is visible by all the big openings; such as windows and doors has direction towards centre of the courtyard or for the part of Mantelgården towards the Mantelgaards own courtyard.

When new visitor centre is designed, I will incorporate these characteristic's in, so that will appear in modern way relevant to the building, but at the same time in a way, where it is possible to recognise the details.



Ill 39 Left: Windows with a place to sit
Ill 40 Rigth: The Watchmans path

Ill 41 Left: Big portholes seen from inside
Ill 42 Rigth: The smaller portholes

SHADOW EXPERIMENTS

Ill. 44: 1st. of April kl. 19.30

Ill. 45: 1st. of May kl. 20.30

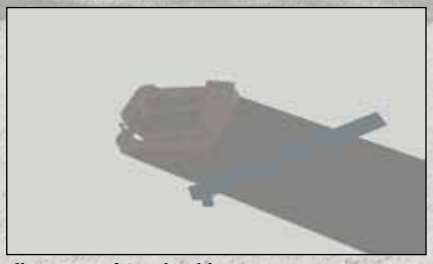
Ill. 46: 1st. of June kl. 21.30

Ill. 47: 21st. of June kl. 20.45

Ill. 48: 1st. of July kl. 20.45

Ill. 49: 1st. of August kl. 20.00

Ill. 50: 1st. of Spetember kl. 19.45



Ill. 51: 1st. of October kl. 18.30

Relating to room organising it could be interesting to see if Mantelgården cast a shadow on site. Because the stables are placed southeast of Mantelgården it is only interesting to study the evening sun. The study has then been done in that exact moment, when Mantelgården cast the biggest shadow on the stable building.
The study shows that shadow more or less only covers the part to the most west; only in April and October the middle building is also covered.
This study should be taken in to the design process and the making of the floor plan, so that functions with the need of sun not is placed in a shadow area. For example should the restaurant not be placed in the west part with windows orientated to the north.

Ill 43: Hammershus

INDOOR CLIMATE DEMANDS

Because the new visitor centre is build on top of Hammershus the new building will be excluded from living up to the building regulations due to the following rule:

"For bygningsfredede bygninger og bygninger, som er del af et fredet fortidsminde, kan der ske lempelser fra bestemmelserne i kap. 2-8, såfremt bestemmelserne skønnes at være uforenelige med frednings- og bevaringsværdierne." (Bygningsreglementet, 1.2 stk. 4)

Regardless of the exception, this project will use the building regulation as a starting point for the design process. Besides the building regulation the Danish Standards will be used to determine the demands for specific parts of the visitor centre. The overall room program demands mentioned earlier in the program is divided in to five different zones. These zones are a restaurant zone, an exhibition zone, a reception, classroom zone and a toilet zone. All zones should be dimensioned to be a category 2 standard; this will be valid for both the thermal indoor climate and the atmospheric indoor climate. The category 2 is chosen because it should be used for new buildings and renovation and gives a normal level of expectation to the indoor climate (DS 15251, 2007:13). The category 2 for the thermal indoor climate gives a divergence of +5 and -5 % of PMV (predicted mean vote), this means a max of 10 % of PPD (predicted percentage of dissatisfied). (DS 15251, 2007:25). In the atmospheric indoor climate the category 2 gives a 20 percentage expected dissatisfied visitors (DS 15251, 2007:32). For creating the best illumination conditions the building is divided in to the same five zones as for the thermal and atmospheric indoor climate. When using the building regulations and the Danish Standards it is important to compare demands, so that it will be the strictest demand that defines the level.

Thermal Indoor climate

In the process of designing a thermal indoor climate in category 2 it is important to look in to the building regulation, and it says, as an overall demands as follows:
"Det termiske indeklima på solrige dage skal dokumenteres gennem beregning for boliger, institutioner, kontorer mm. i lavenergiklasse 2015 og bygningsklasse 2020. Det termiske indeklima må ikke overskride 26°C, bortset fra nogle få timer i forhold til normalåret. For andre bygninger end boliger fastlægger bygherren antallet af timer pr. år, hvor indetemperaturen på 26°C ikke må overskrides. For boliger må 26°C ikke overskrides med mere end 100 timer pr. år. og 27 °C må ikke overskrides mere end 25 timer pr. år. " (Bygningsreglementet, 7.2.1, stk.13)

If we look in to Danish Standards the demands will be as follows:
Opening hours for the new visitor centre will on yearly basis be placed from Easter until end of middle of October. The visitors will therefore arrive in a dresses between 0,5 clo and 1,0 clo. The activity level in the different zones of the visitor centre will be set to 1,2 met (DS 15251, p.26) because an activity level at 1,2 is sedentary activity, which will be the activity level in the visitor centre. With 1,0 clo for maximum clothing and 1,2 met for the general activity a comfort temperature for category 2 quality standards will be min 20 degrees Celsius for the winter period and maximum 26 degrees Celsius for the summer period DS 15251, 2007:26).

The 26 degrees Celsius as mentioned both in the building regulation and Danish Standards will therefore maximum temp set as maximum while 20 degrees Celsius will be demands for the minimum temperature.

Atmospheric indoor climate

The building regulation has following demands:
"Undervisningsrum i skoler og lignende skal ventileres med et ventilationsanlæg, der omfatter såvel indblæsning som udsugning og varmegenvinding.
Indblæsningen med udeluft og udsugningen skal i normalklasserum være mindst 5 l/s pr. person, samt 0,35 l/s pr. m^2 gulv, samtidig skal det sikres at CO2 indholdet i indeluften ikke i længere perioder overstiger 0,1 pct. CO2." (Bygningsreglementet, 6.3.1.3 stk.2)

For a classroom with 30 students living up to the demands from HFB of maximum 40 pupils in a classroom of 65 m2 (HFB, p. 275) it will give a air change rate of:
(40 pupil*5 l/s+0,35 l/s/m2*60m2)= 3,7 l/s/m2

The demands from the building regulation only concern classrooms for other zones the building regulation refers to individual dimensioned ventilation decided by the city council. Danish Standard on the other hand determines an air change rate in category 2 for the different zones. To decide the air change rate the visitor centre is set to be a very low polluting building. This means that building shall be in natural materials such as stone, glass and smoking will never occur.
This gives following air change rate the summer period (Open period from 1st of

April until 31st of October) and winter period (closed period from 1st of November until 31st of March):

Restaurant: Summer: 5,2 l/s, m2, winter: 0,3 l/s, m2)
Exhibition: Summer: 3,8 l/s, m2, winter: 0,3 l/s, m2)
Reception: Summer: 3,8 l/s, m2, winter: 0,3 l/s, m2)
Classrooms: Summer: 3,8 l/s, m2, winter: 0,3 l/s, m2)
Toilets: Summer: 3,8 l/s, m2, winter: 0,3 l/s, m2)
(DS 15251, 2007:34)

If the demand from the building regulative is hold against the demand from DS 15251, the demands from DS 15215 shows as the strictest and will therefore be the demands, that will be taken in to Be10 and BSim.

Illumination conditions

The visitor centre has, as earlier described, the presentation and communication in focus. With a building that works both as a museum, restaurant, kitchen, office and classrooms a range of different demands to the illumination is made. For the rooms it is given, that they are a part of the story telling for the place and have different functions in that storytelling and therefore also different demands. For the restaurant is not a given minimum, because it is depending very much of the mood created in the restaurant, but at the same time the light should have so many lux, so it doesn't irritate the visitors. The restaurant is therefore put in to the category "other rooms". In DS 700 the demand for this category is 200 lux. For museum the light should again be a part of the storytelling for Hammershus, but also play different roles in the exhibition and still let the exhibition have the possibilities of using video and 3D. A relevant lux demand could be 50 lux. This lux is the demand for corridors and stairs (DS 700, 2005). By choosing min 50 lux for the exhibition area it is still possible to get around without falling, and at the same put spotlight on the things on display, and in this way make a clear difference. For the classroom and kitchen area Dansk Standard have a demand of 200 lux (DS 700, 2005) and Bygningsreglementet have following rule of thumb:

"I arbejdsrum m.v., beboelsesrum og køkken kan dagslyset i almindelighed anses for at være tilstrækkeligt, når glasarealet ved sidelys svarer til mindst 10 pct. af gulvarealet eller ved ovenlys mindst 7 pct. af gulvareal, forudsat at ruderne har en lystransmittans på mindst 0,75." (Bygningsreglementet, 6.5.2, stk.1)

In the further design process it is important to note the rule of thumb given in the building regulation. That rule will give the demanded light in the relevant zones and therefore make the electrical light more unnecessary, and in that end keeping the energy use low.

APPROACH TO TRANSFORMATION FROM RUIN TO VISITOR CENTRE

When the new visitor centre is created it is of a significant importance to be aware of the developer's primary requests. As described in the earlier paragraph, the overall main request is to create a visitor centre that is able to communicate the history of Hammershus thereby also meant:

The relation and hierarchy between the existing ruin and the new visitor centre.

With a site within and on the ruin, it is therefore important to be aware of the existence of different approaches to transform a former ruin to a in to a modern visitor centre. By studying different transformation projects I will therefore gather information on how different approaches have different impact on the final building. After the cases I have made a sum up with the conclusions that would relevant to bring in to the design process.

Ill 44: Castelvechio

Carlo Scarpa - Castelvecchio

At Castelvecchion existing spatiality's are changed and walls are removed. The building and the existing rooms are transformed into a new kind of spatiality.

The result of this approach is that the new building adds a new layer to the existing building, which prompts new functions but at the same time also removes the focus from the past of the building. On the other hand, the new layer allows changing the former purpose of the building into a new one. An example of this approach is seen on the illustration above. Here the stairwell and podium change the experience of the room radically, so that the visitors can have problems scanning the historic layers of the building.

Sverre Fehn – Hamar Bispegård

At Hamar Bispegaard the new building work is placed on the existing building with a new spatiality but the existing spatiality is maintained as a part of the new building work.

The result of this approach is that the visitor will be an observer of the original story without taking part in it. On the other hand the approach allows the place to create a spatially that serves the new purpose of the building much better - without changing the original layer of the building. Sverre Fehn has in his project Hamar Bispegård Museum used this approach. It is seen at the entrance and through show rooms, where a big ramp of concrete is placed.

Ill. 45 Sverre Fehn - Hamar Bispegård Museum

Exner – Koldinghus Slot

At Koldinghus the existing ruin is rebuild with the same form and expression as before it was abandoned.

This approach focuses on the original appearances and spatiality of the castle. The visitor will in this way be able to reconstruct and imagine the original life in the castle. In the design process of making tranformations like Koldinghus, Johannes Exner did make use of a concept called - reversibility. "Reversibility means the physical form that is used in a transformation process which enable the fact that it can later be removed without making any damage on the original building that hereafter appears just as intact as before the transformation process"
(Exner, 2007)

The outside of Koldinghus Slot is an excellent example of this approach and concept. Inside the reconstruction has been done in a more limited degree. Johannes Exner has reconstructed the castle, and the new workings are true to the facade in the original castle. A clear difference between new and old materials has been chosen, so that the new added layer of the history in the building is clearly visible. Visitors are therefore not in doubt about what is new and what is from the of the original castle.
The inconvenience of this approach is the limitations of the original spatialities.

Summery

Naturstyrelsen wishes that the new visitor centre focus on the communication and presentation of Hammershus. In other words, Naturstyrelsen focus on the communication of the past of the location, the communication of the building throughout past and partly the communication of the current Hammershus. To create the best physical surroundings for the presentation of the former everyday life at Hammershus the development of the new visitor centre should therefore relate more to Exner and Fehn. These approaches communicate the original functions and layers and only add a very adjustet layer, which do not change or remove parts from the existing layers. Using this approach can also help to keep the hierarchy in the courtyard, where Mantelgården is the main attraction. But because the stables and the original spatialities within is not created to be a visitor centre it could be necessary to add walls like Scarpa. If this is necessary it should be as gentle as possible, so that the expression of the courtyard is the same.

Ill. 46 Exner - Koldinghus Slot

PROGRAM SUMMARY AND CONCLUSION

Hammershus is every year visited by all kinds of people including families, classes, people who pay special attention to the ruin and people who pay special attention to the landscape. With 400.000 yearly visitors, the centre has to be able to handle the great amount of visitors in a way that they will experience as few inconveniences as possible. This means that the visitors come with a variety of different goals that have to be combined to create the best possible experience for them all.

According to Naturstyrelsen it is highly important that the new visitor centre do not overshadow the landscape. Instead, it should fall into the landscape and help to communicate it. The ruin has a very special location in the landscape, and that location the visitors should experience in spite of the new visitor centre. It is also important that the exhibition is a substantial introduction to the castle including the former daily life at the castle and the history on the site.

In the program from Naturstyrelsen it says that the new visitor centre should be placed in the area south west of the ruin. However, with its natural location in the ruin and on the top of the landscape the stables is the perfect place for a new visitor centre. To experience the history of Hammershus it is naturally to place the visitor centre and exhibition exactly where the history has unfolded. In this way, the visitor centre will fall into the history that is told by Hammershus and it can work as a centre for the visitors from where they can experience the ruin. Furthermore, the stables should frame a room for contemplation, so that dog walkers and families enjoying the view do not disrupt the many pupils and visitors who want to concentrate about the history. By its location in the stables the hierarchy of the ruin will be maintained with Mantelgården as the natural centre.

In the transformation process, it is important that all the layers are recognisable so that the visitors can easily distinguish between the ruin and the new building. A summary of this lead to the vision on the next page.

Ill 47: Hammershus

The vision of this project is to create a new visitor centre that through transformation and rebuild converts the ruin of Hammershus into a modern visitor centre. This centre should tell all the aspects of the history of the old castle of Hammershus and at the same time make use of the qualities of the remaining ruin in the new story telling. The narrative of the site should become a natural part of the building so that the visitors will experience it knowingly and unknowingly.
The transformation should frame a room for contemplation that take all the different types of visitors into account, but it has to be designed in a way that maintains the landscape and the hierarchy herein.

Ill 48: Hammershus

Design development

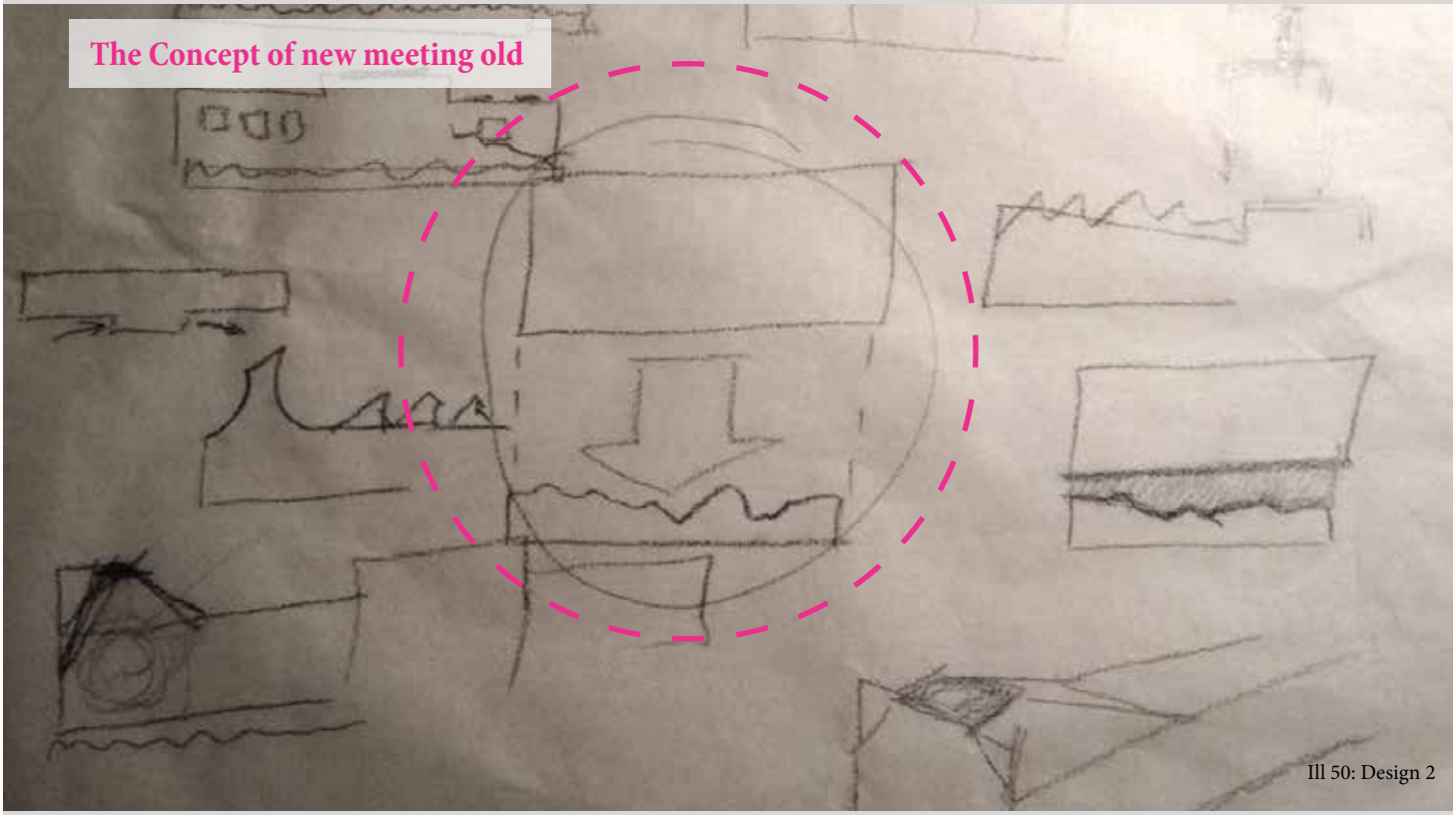
To live up to the vision the design phase has to contain and relate to the different parts studied in the program phase. The way this is done is by working in different iterations, where different factors from different parts in the program influence on each other. In the description of this design phase it is simplified in to different main subjects processed individually.

Ill 49: Design

CONCEPT DEVELOPMENT

In the initial phase of sketching the history of Hammershus as a castle played a big role. From developers point of view the presentation of the history is the most important thing, and the design therefore had to counter this. By this means the new visitor centre should open op towards the centre of the courtyard, and close of towards the surrounding areas outside the walls. This should be visible in the way people use the building in other words, people should be closer to the centre of the court yard than the outer walls. It should also be visible in the facades with more openings towards the centre of the courtyard amore detailed describtion can be read in the following paragraph introvert orientation. Besides the opening to the court yard the overall clash between the new visitor centre and the existing ruin should take form. The clash was choosen to be a modern homogenous form that should meet the ruin as seen on the picture below. This creates a modern room that draw attention to and respects the ruin.

Introvert orientation
With up to 8.000 visitors at Hammers-hus on the most crowded summer days it is important to think of how the best way to make conditions for communication and presentations of Hammershus is made.
In that sense it is also worth noticing that the original orientation for Mantelgården was inward for protection against enemies with only a very few windows pointing outwards. Therefore the orientation of the rooms will be inwards. In this way it is possible to cut off visitors who is not visiting the museum, so that these visitors won't disturb the guests at the museum and restaurant.
This means, that all the presentation and communication of the rooms in general will be orientated more inwards to itself and inwards towards the courtyard.



Ill 50: Design 2

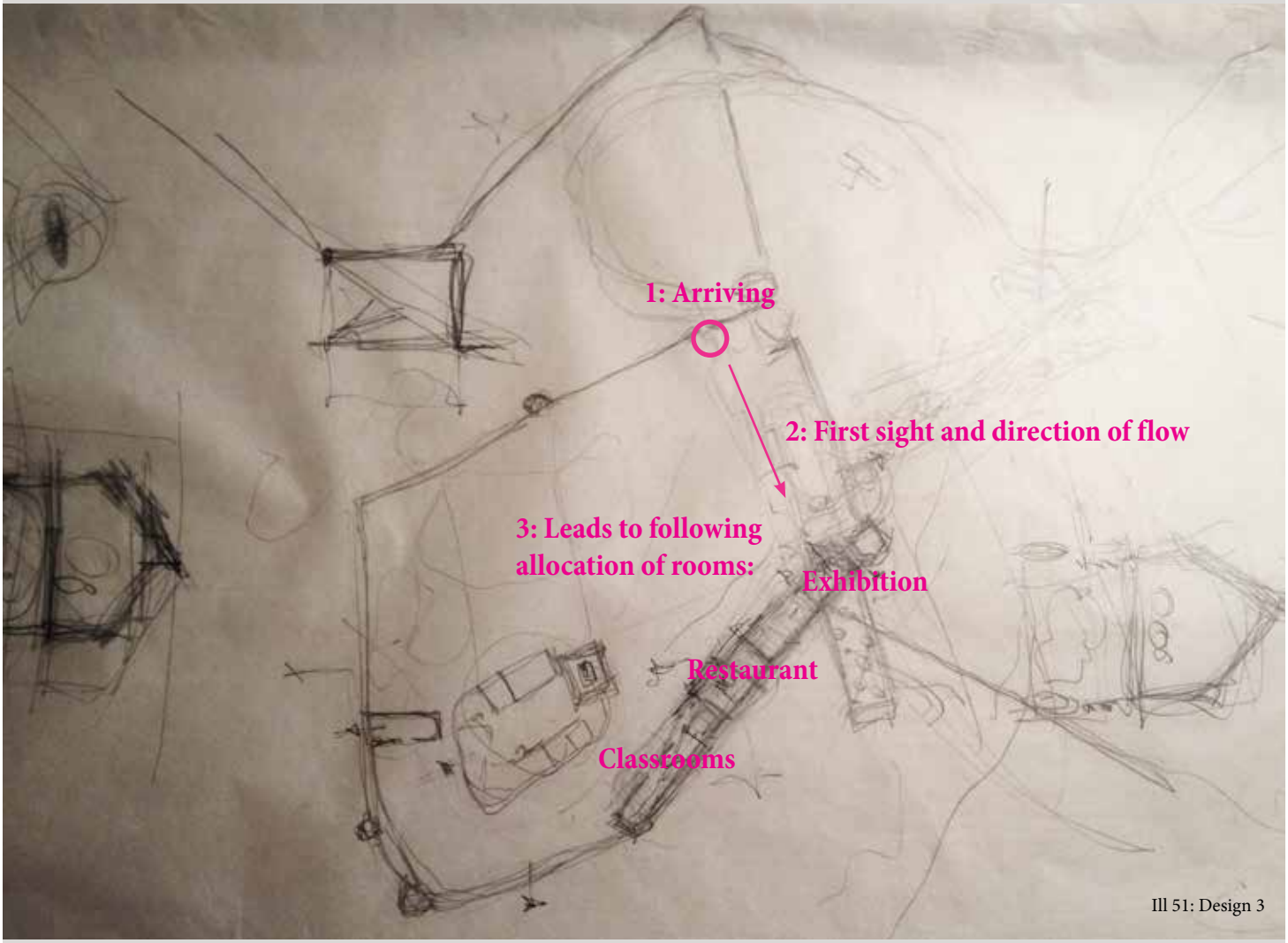
ALLOCATION OF ROOMS

The room demands was split in to three parts like the contour of the three original buildings (two stables and the barn) within the site of the stable. These three parts was put in to a hierarchy of which of the three parts the visitors should meet at first sight and which of the buildings that would be the most relevant for tourists arriving at Hammershus.

The buildings and hierarchy is:
1: Exhibition
2: Restaurant
3: Classrooms

The reason is as follows:
All tourists should meet the exhibition, and shouldn't be in doubt where to get information about the ruin. Many tourists would probably like to by refreshment. Only school classes and people going to conferences need to go to the classrooms.

With this in mind hold against the flow diagram and the shadow investigation it gave the overall allocation of the rooms.

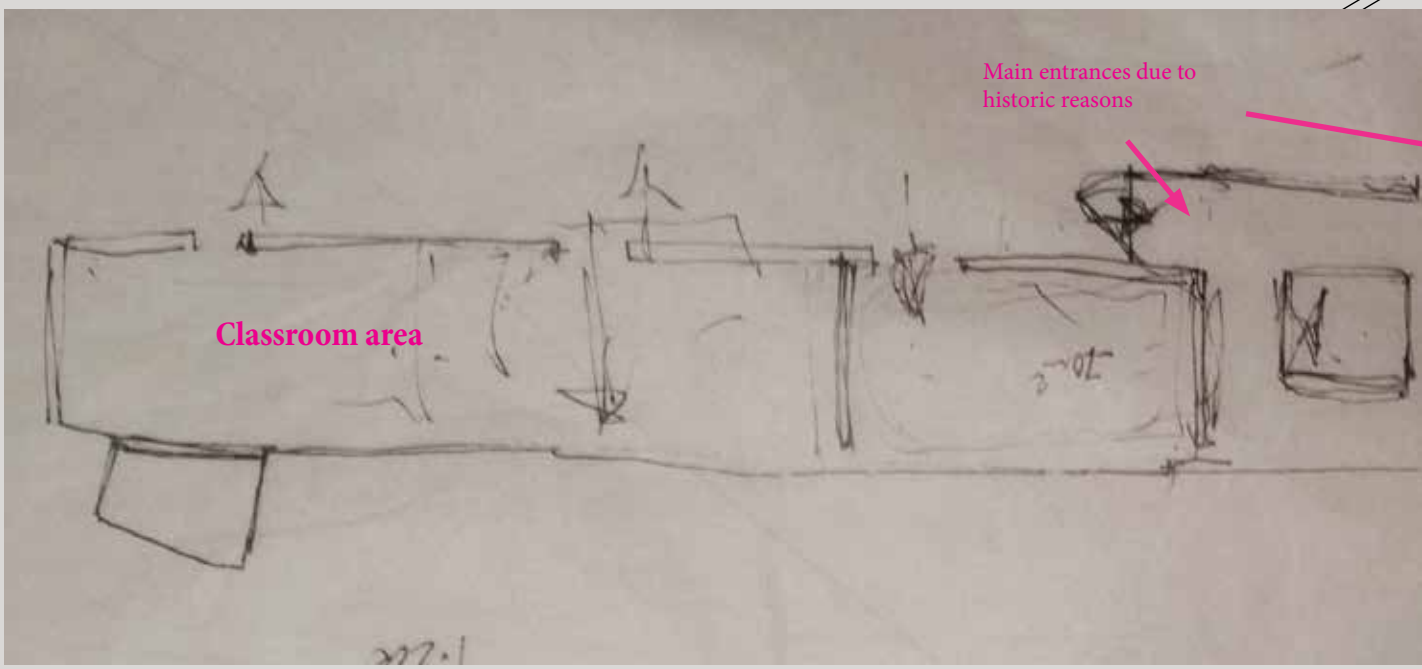


Ill 51: Design 3

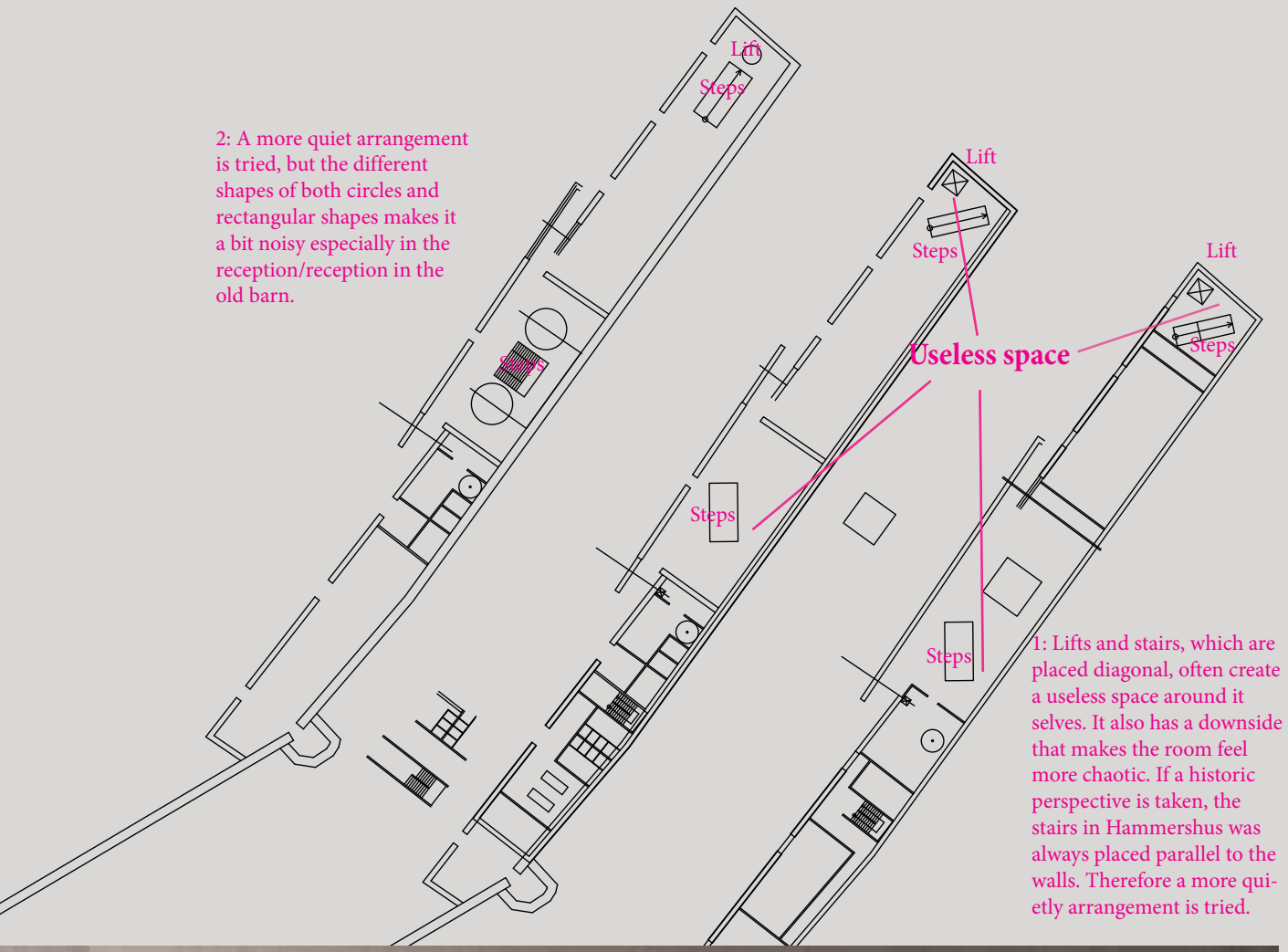
PLAN DEVELOPMENT

At first the room program was fitted in to a single plan building, but seemed to tight and couldn't live up to the demands from the room program without a considerable extension to the buildings, a first floor or a basement. The program therefore was build around and into a two-plan building. Following a two-story building are also the demands of stairs and lifts. Together with stairs and lift are created spaces around those. Different try-outs were made, and from here it ended up with a sketch as figured in the bottom of this page.

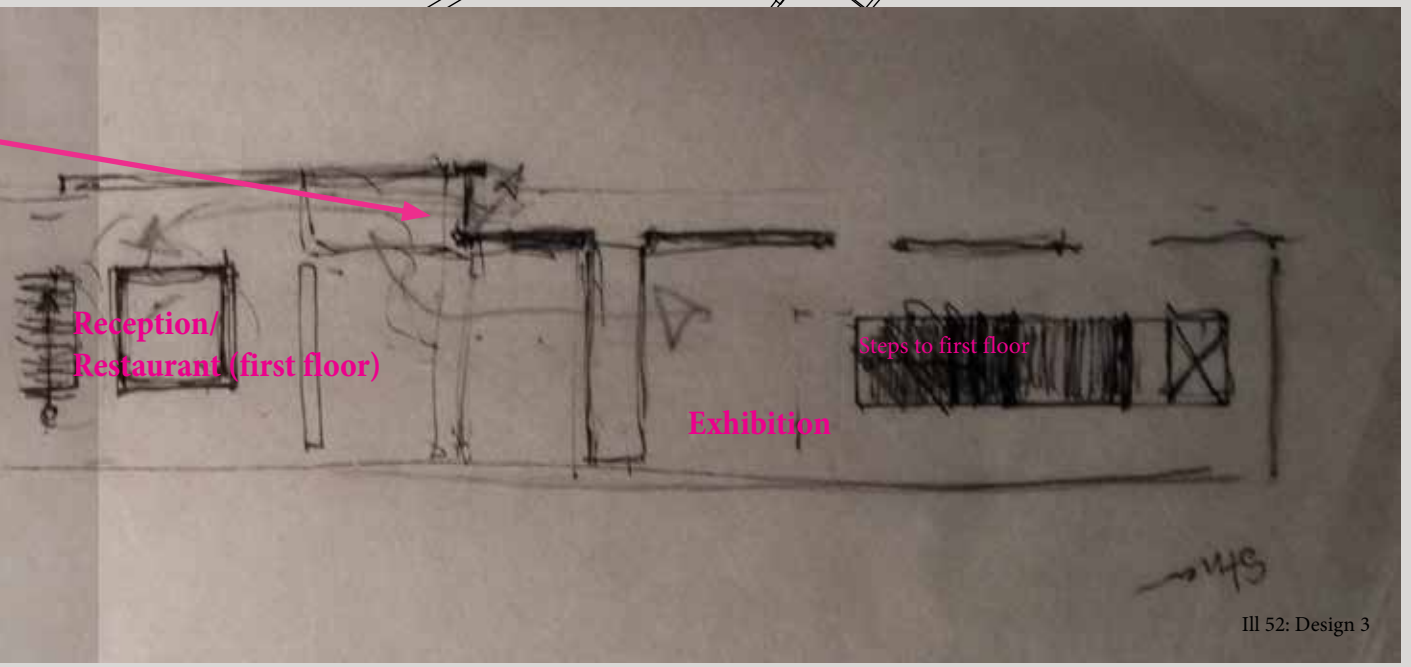
3: The circular shapes have been changed to squares. The squares and steps are placed parallel to the existing walls. This creates a more calm room. The entrance to the reception area is the same as in the old barn. This gives a good historic reference. Therefor this arrangement is taken further on.



2: A more quiet arrangement is tried, but the different shapes of both circles and rectangular shapes makes it a bit noisy especially in the reception/reception in the old barn.



1: Lifts and stairs, which are placed diagonal, often create a useless space around it selves. It also has a downside that makes the room feel more chaotic. If a historic perspective is taken, the stairs in Hammershus was always placed parallel to the walls. Therefore a more quietly arrangement is tried.



Ill 52: Design 3

HEIGHT REFLEXIONS
-RELATION TO BLOMMETÅRNET

The new visitor centre should as earlier described fit in to the hierarchy of Hammershus. To maintain the ruin of Hammershus as the most important buildings at Hammershus, it is therefore important to maintain the hierarchy of the buildings. This means that the relation between the new visitor centre at site two and the near by Blommetårnet is very important.
In the development of heights, different heights have been tried.

The height of the existing Blommetårnet is 8 metres to the roof edge and 11 metres to the ridge.

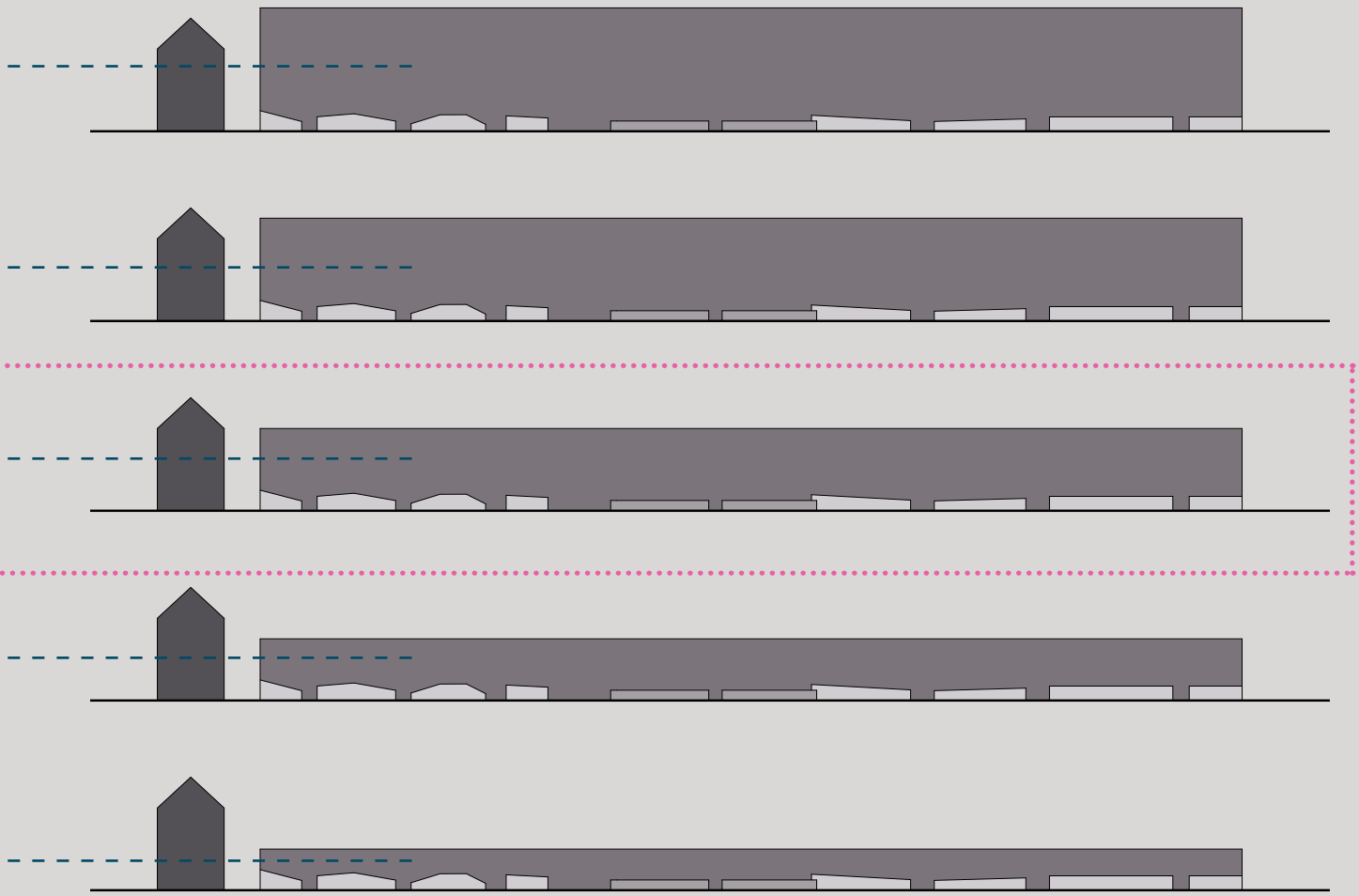
12 metres - This height makes the new visitor centre to dominating and overrules therefore the existing ruin.

10 metres - The height is lower than ridge but higher than the edge. This height maintains the hierarchy partly. This hight can therefore be used in parts of the building.

8 metres - This height maintains the hierarchy, and plays well against the existing Blommetårnet. The height is also the original height of the stables at the site. The building still seems long. This height is chosen as main height in the further development process.

6 metre - This height maintains the hierarchy, but looks a bit pressed down. Two low storeys are allowed. This gives a perfect amount of square metres compared to the demands. The proportions still makes the building long and flat.

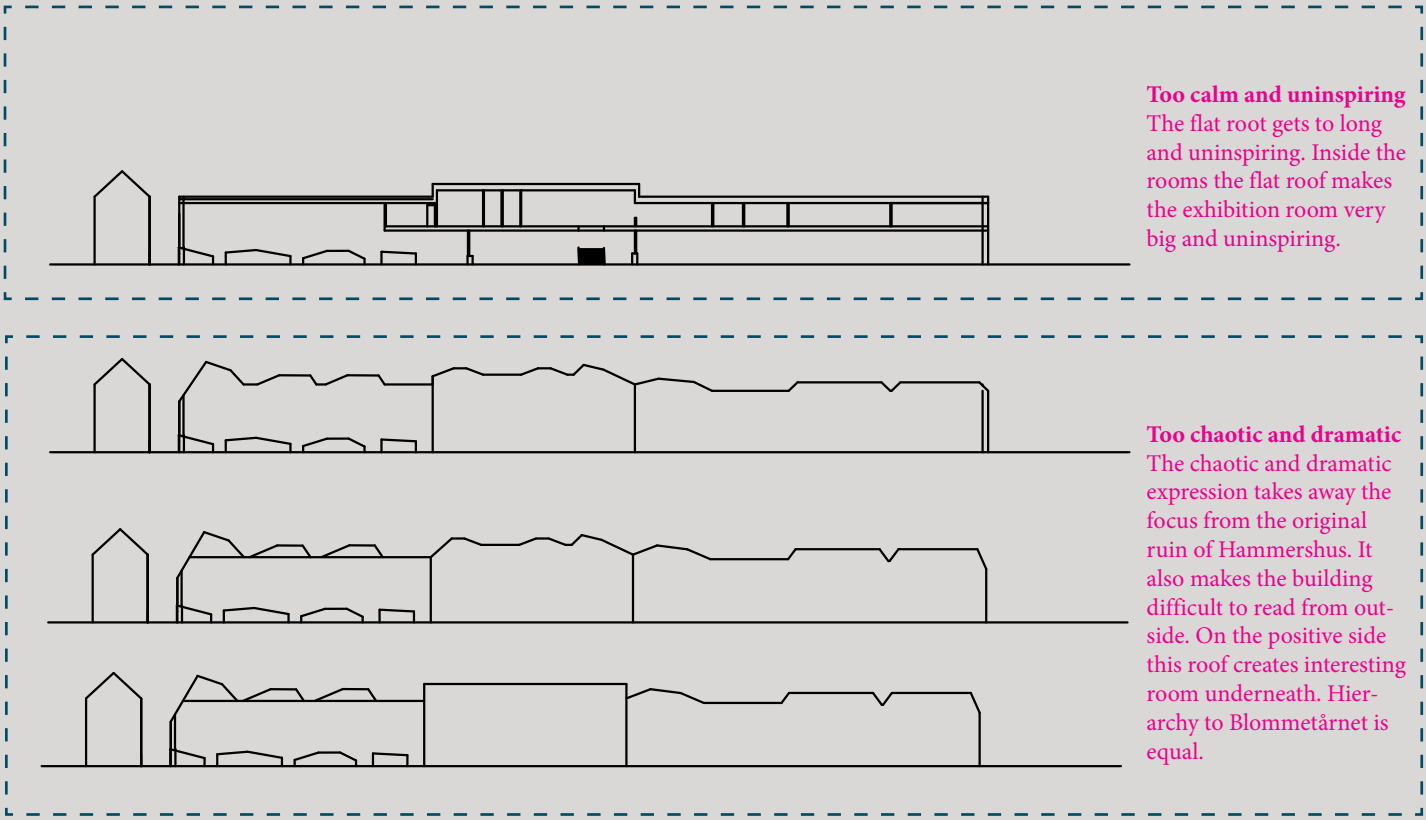
4 metre - This height maintains the hierarchy, but only allows one storey above ground. This gives in all to few square metres compared to th demands. The proportions makes the building seems very long.



Ill 53: Heights

FACADE AND ROOF DEVELOPMENT
- In relation to form

To create an interesting facade the roof development is one parameter. Different expressions was tried to create interesting facades. The demands was, that the facade should create an interesting façade, make spaces for interesting rooms inside, keep the height hierarchy to Blommetårnet, make the possibility to create a good indoor light and don't drag attention away from the rest of the ruin.
Overall many of the shapes were too chaotic and did drag too much attention. Second of all many of them drew references to factories. The conclusion was, that a calmer facade was needed. The further investigation can be seen on following pages.



Too calm and uninspiring
The flat root gets to long and uninspiring. Inside the rooms the flat roof makes the exhibition room very big and uninspiring.

Too chaotic and dramatic
The chaotic and dramatic expression takes away the focus from the original ruin of Hammershus. It also makes the building difficult to read from outside. On the positive side this roof creates interesting room underneath. Hierarchy to Blommetårnet is equal.

Ill 54

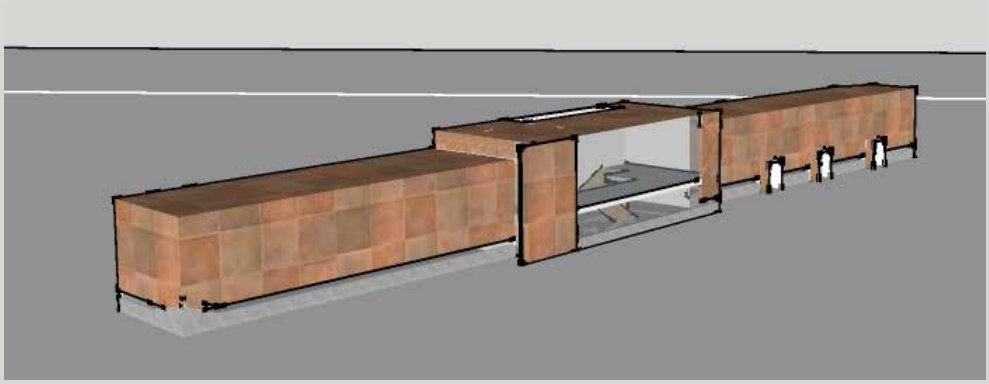
A reference to a factory
Repetition of different shapes gives a impression of a factory. Underneath is created interesting rooms. The repetition gives the possibility to create angled roof light. Skipped because of the factory reference.

Ill 55

FACADE AND ROOF DEVELOPMENT
- In relation to form - part two

With the experiences from the facade and roof experiments in mind try-outs to create a at same time calm and interesting facade. A facade that at the same time also creates the possibilities for creating interesting rooms underneath. It lead to following:

1:

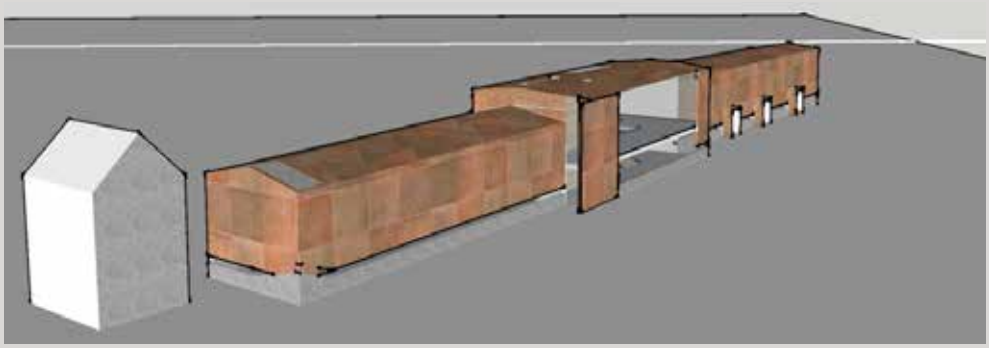


Ill 56

Positive:
The flat roof points out the form, keeps the hierarchy and let the remaining walls stand out.

Negative:
The flat roof has a tendency to create rooms underneath which can feel homogenous if the room height doesn't change inside. From a constructive point of view it can be hard to direct rain of the roof.

2:

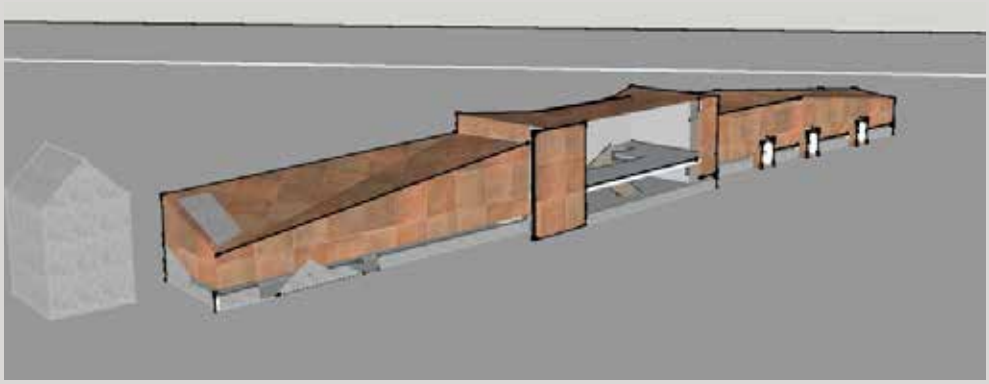


Ill 57

Positive:
The rain is lead off. The facade seen from the end is broken. It refers to the original roof, which was supposed to be a saddle roof. The form keeps the hierarchy and let the remaining walls stand out.

Negative:
The long facade still seems to long and homogeneous which makes the building look even longer.

3:

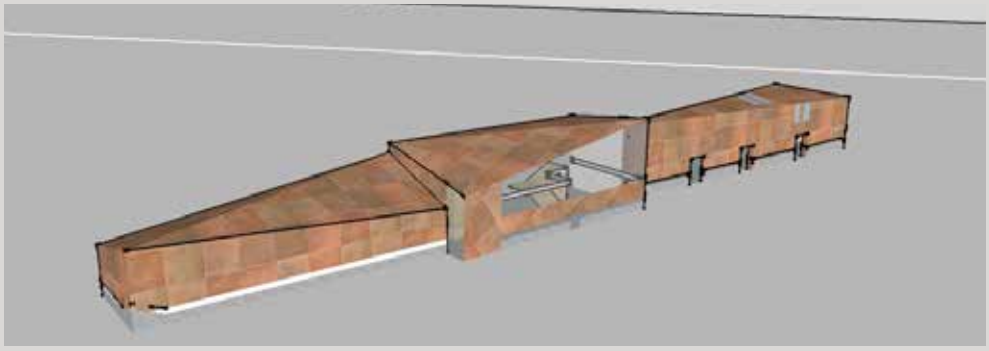


Ill 58

Positive:
The form breaks up the feeling of a long building. Give the possibility to create interesting rooms underneath. Hierarchy to existing walls are maintained.

Negative:
The exhibition room creates a slope; so all the water is lead to the same spot. Windows points to a direction that's not relevant for the rooms underneath (see more detailed description on following page)

4:



Ill 59

Positive:
The building opens up in the corner where visitors see it at the first time. Roof windows points towards relevant directions(see more detailed description on following page). Hierarchy to existing walls and Blommetårnet is maintained. Rain lead off to different directions.
This form is therefore the form, that is brougth to next level.

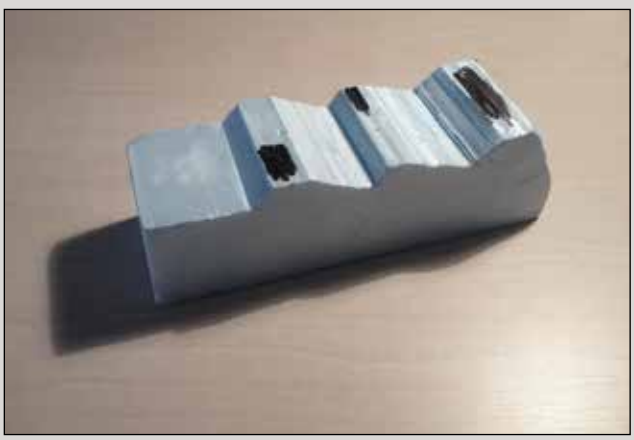
WINDOW DEVELOPMENT

In the process of development the windows was overall developed in the with the illumination demands described in the program in mind. In the process a change between designing the roof after how the windows needed to be placed and placing the windows in the roof and walls with the roof as a controlling factor. The foam models were try-outs in that process before ending up with solution described on the opposite page.

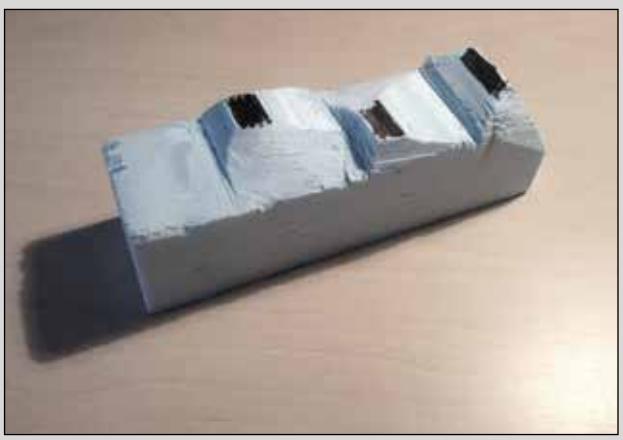
Ill. 60

Ill. 61

Ill. 62



Ill. 63



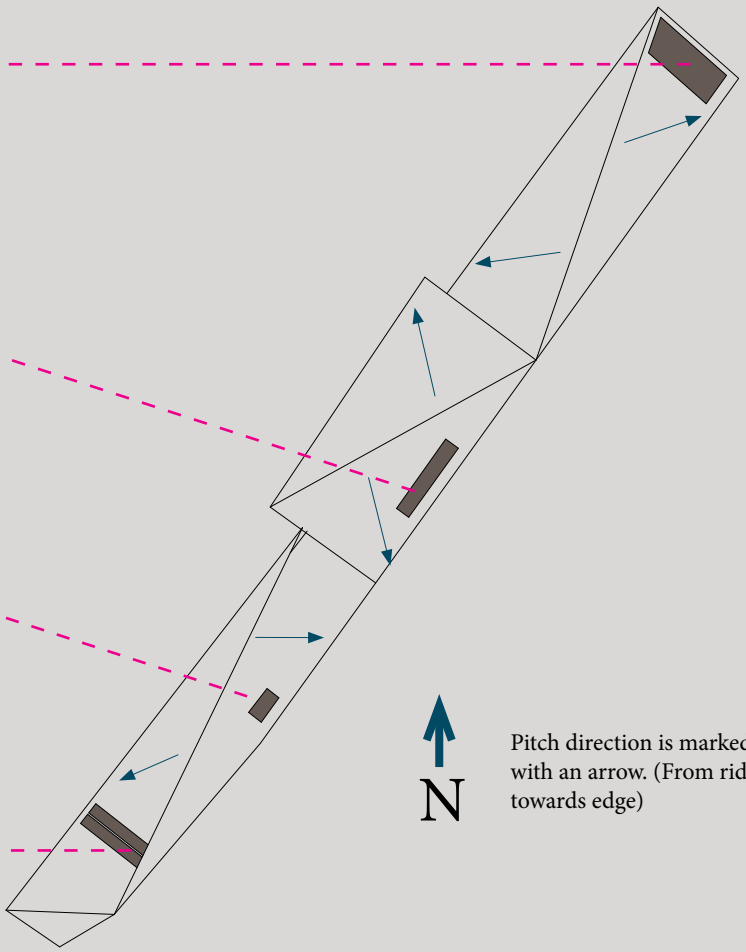
Ill. 64

Exhibition room:
The most visitors will arrive between 12 pm and 6 pm. With a window pointed towards southeast direct sun is avoided in that period. Visitors will therefore not get irritated in the exhibition from direct sunlight.

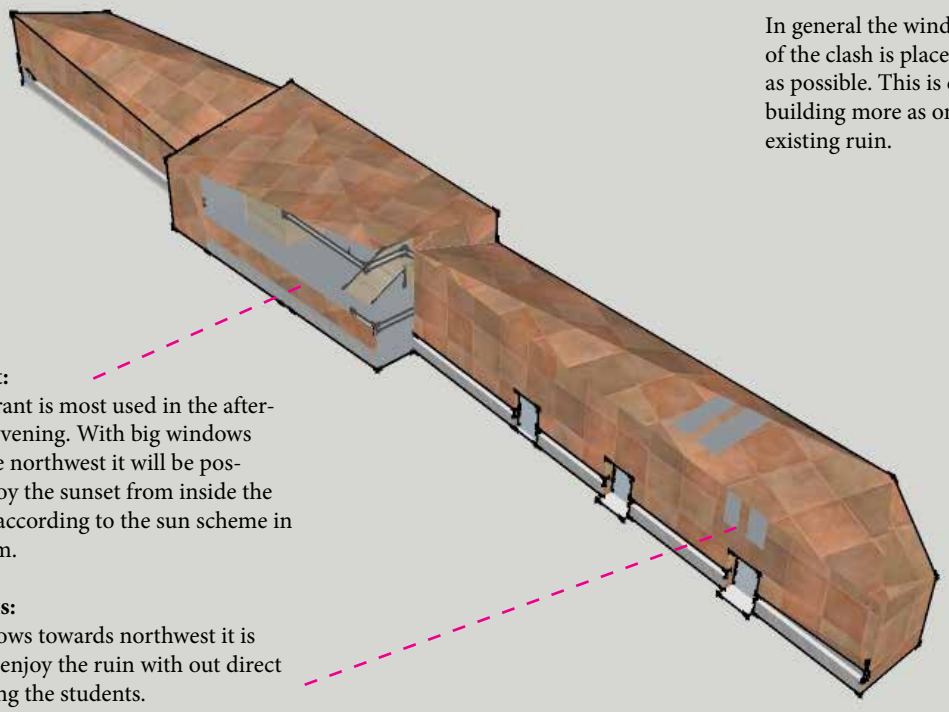
Reception/Restaurant:
Most used by tourists for the museum and restaurant from 12 pm. until 6 pm. A tilt towards southeast will allow the sun to get direct in to the reception. The reception will in this way be lightened up, so that the double high area will seem bigger.

Stairs to the classroom area:
The classrooms are most used during the morning. With a tilt towards southeast the window allows the sun enlighten the stairs when students are arriving at Hammershus.

Classrooms:
With a tilt towards northwest the windows will light up the room without letting the sun in in the most period in the morning.



Pitch direction is marked with an arrow. (From ridge towards edge)



In general the windows that are not a part of the clash is placed as far out in the facade as possible. This is done to make the new building more as one unit attached to the existing ruin.

Restaurant:
The restaurant is most used in the afternoon and evening. With big windows towards the northwest it will be possible to enjoy the sunset from inside the restaurant according to the sun scheme in the program.

Classrooms:
With windows towards northwest it is possible to enjoy the ruin with out direct sun irritating the students.

Ill. 65

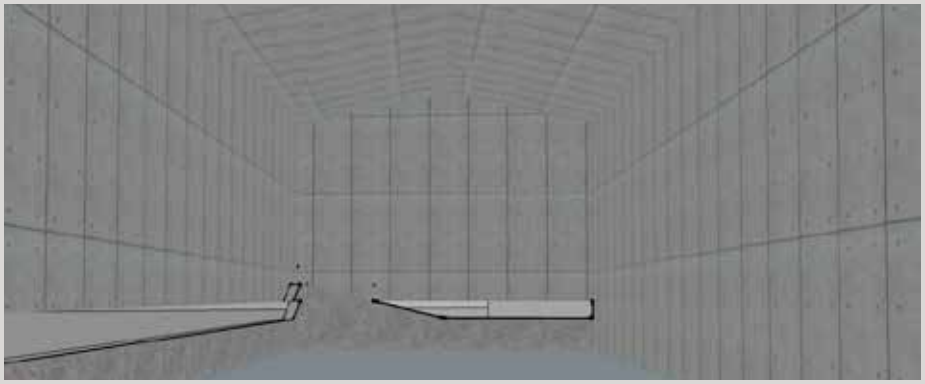
EXHIBITION PRINCIPLES

The existing Hammershus exhibition is today placed in a very homogenous room of 75 m2. The exhibition does mainly consist of a small models and posters. The exhibition is characterised by years of use. In the research of how an inspiring and interesting exhibition could be made, I have therefore looked in to other exhibitions, and from there tried to drag out the essence. For making interesting rooms for exhibition the rooms should vary in all kinds sense. This means both in height, shape and lighting. Besides the, at this page posted, exhibition building, I have looked into among others Sverre Fehn's Hamar Bispegård as seen on page 49. On the picture of Hamar Bispegård it can be seen that the room is not synchronous, this helps making the room more uneven, and that gives a more interesting experience. On this page the picture shows BIGs new museum in Blåvand. Here different room heights, different lighting and a non-regular and a immeasurable form makes an interesting room. From the developer's point of view, they would like to have the possibility to present archaeological items, models, bigger items in scale 1:1 and a possibility to show video (Bjerregaard, 2013).
At the same time it is important, that it is easy to get around in the exhibition with out getting lost or miss essential places.
It is therefor important to take both parameters relating exhibition and parameters relating to internal flow in to consideration in the development of the new visitor centre and especially the exhibition part of the new visitor centre.

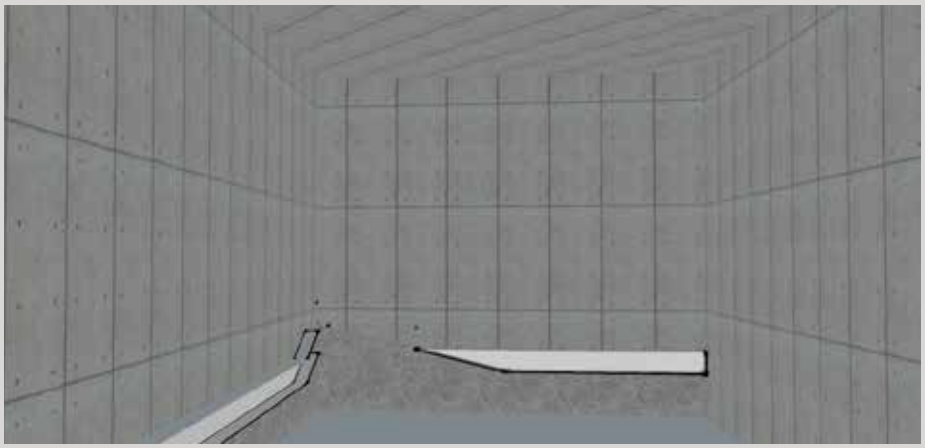
Ill. 66: BIG - Blåvand

ROOF EXPERIMENTS
- IN RELATION TO EXHIBITION ROOM

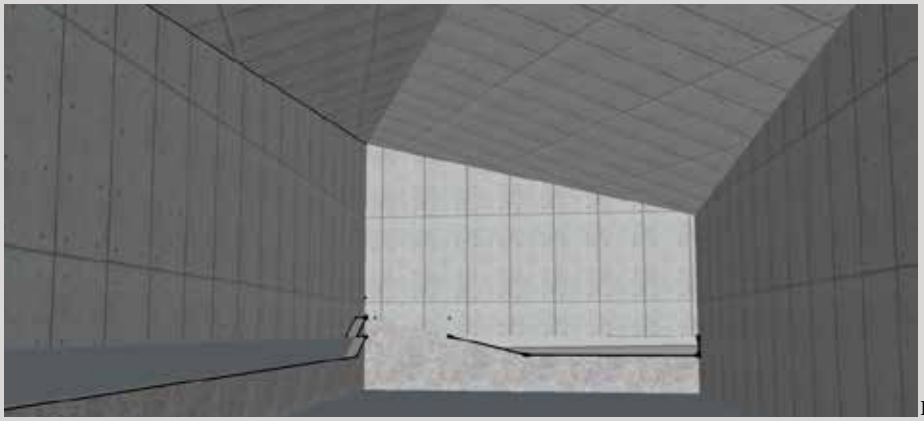
"Saddeltag"
The exhibition room does not provide any interesting corners or shapes. The room gets high and long.



Flat root
The exhibition room is a plain room without any interesting corners. An exhibition in this room could easily end up having the same moode all way through because of the evenness in the room

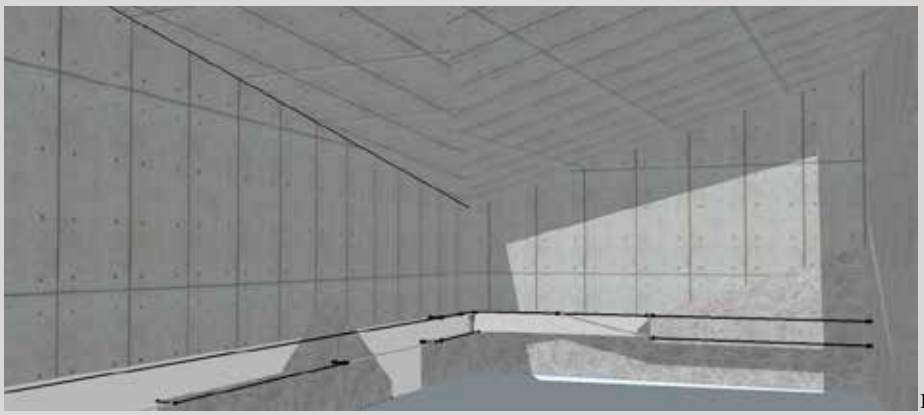


Ill. 67



The broken roof 1 and 2
The room makes shapes and corners. This will provide a possibility to create different moods in the same room. According to the way the roof brakes, different shapes and moods can be made. The breaking roof is also better for the acoustics than the other two examples. Due to the advantages of the breaking roof from an exhibition room point of view this type of shape will be taken further on in the process.

Ill. 68



Ill. 69

THE CLASH

In the development of the meeting between the existing walls and new walls forming the new visitor centre, the presentation and communication of the story of Hammershus has again been the important factor. Therefore there have been made systematic look into existing the wall height as seen in the program. With walls heights in general around 1 metre, the walls are only defining the site, and does still leave the possibility to look across them. To get the best possible communication of the story of Hammershus the existing walls will be left untouched, and the new rooms will be fitted into these spaces. The new wall will then be build as a reproduction of the original wall on top of it. This is done for keeping the storytelling of the total site of Hammershus in the centre. When the new wall is build it is important, that the visitor can tell the difference between the original walls and the new walls and the keyword will therefore be contrasts. Try-outs of different collisions are described underneath. All try-outs have been made with the investigation of transformation from the program in mind.

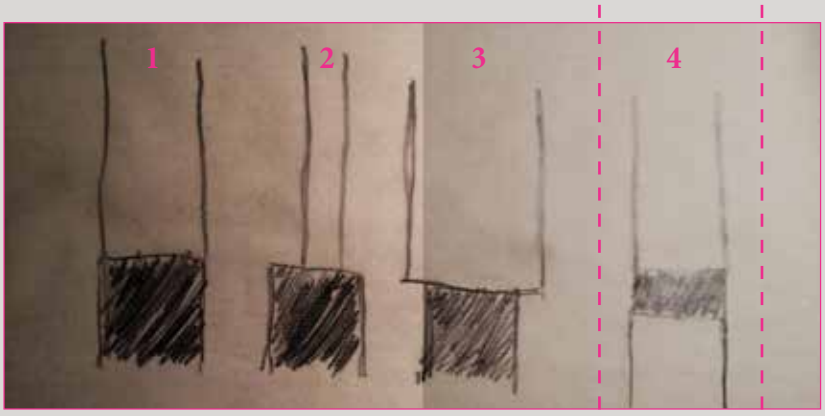
In crooss section

1: Equal wall thickness
The equal wall thickness makes the hierarchy of the walls equal, but the new wall press the existing wall towards the ground.

2: New = thin, existing = thick
The new wall looks attached in a unnatural way. The wall also looks a bit fragile.

3: New = Thick, existing = thin
The new wall seems very heavy and is pressing the existing wall even more than number 1.

4: Equal wall thickness with a separating band
The separating band helps making the clash more elegant, and it makes the walls stand out from each other. The band though still makes the walls look heavy. Is taken to a further level.



Ill. 70

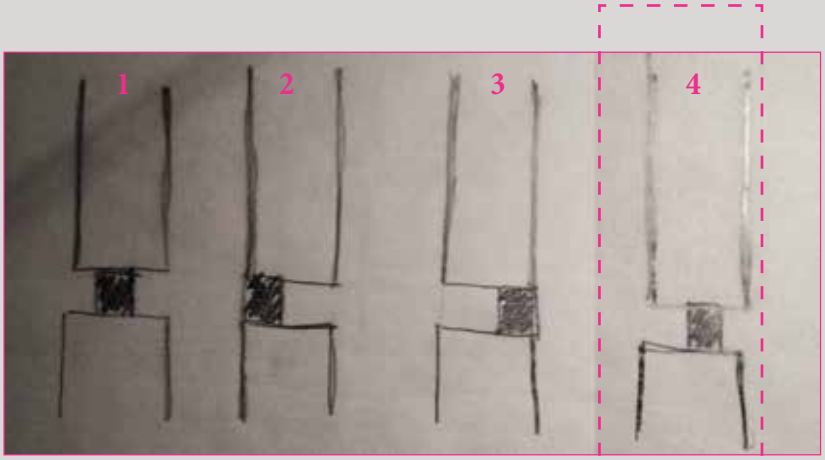
Band try-outs

1: The band placed in the middle
A thin band makes the contrast between new and existing sharper. Placing the band in the middle level out the differences between outside and inside.

2: The band placed in the outside.
Sharpens the contrast from the inside, but makes the contrast from outside disappear. This is not advisable because the walls will be seen from both outside and inside. The wall also looks like is going to tilt inwards.

3: The band placed in the inside
Sharpens the contrast from the outside where most people will experience the clash. Makes the contrast disappear inside. This is not advisable because the walls will be seen from both outside and inside.

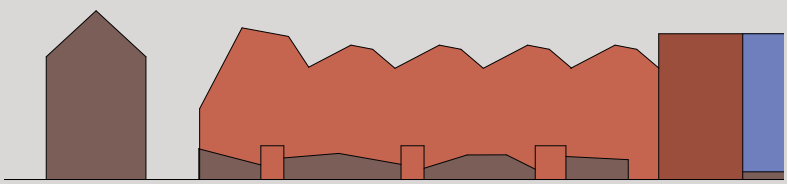
4: The band placed a bit more towards inside than outside
Sharpens the contrast both outside and inside. Makes the clash a bit sharper from the outside, where most people will see it, but the clash is still clearly visible from the inside. Therefore this model is chosen.



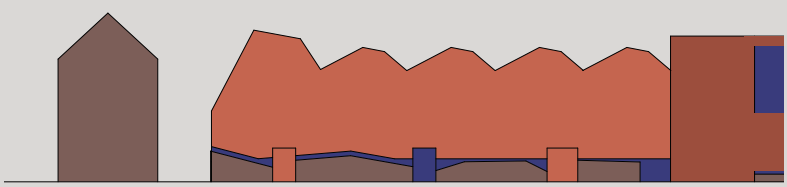
Ill. 71

Seen from front

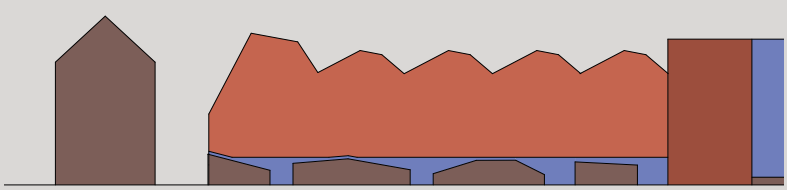
Different try-outs has been made with the focus on how the buildings parts (the new and old walls) appear in proportion to each other. Some of the most important try-outs are presented here.



The new wall follows the existing wall
The new wall presses down the existing wall, so that it doesn't stand out and instead gets more flat. The new wall seems very heavy.



The new wall follows the existing wall divided by a band
To increase the contrast between new and existing walls a band is introduced. This makes the existing walls more heavy and let them stand out better. The new wall still press the existing wall down.



The new wall is sharpened
The band makes the existing wall stand out. The sharpened bottom edge on the new wall makes it look less heavy and strengthens the contrast between new and existing. The band will be in glass and help getting light on to the building. Therefore this iteration is carried on.

MATERIALS

In the research for finding relevant materials that could be used in the new visitor centre, there has been looked at materials relating to war, concerning that Hammershus was build in a period with many wars. There has also been looked in to which local materials Bornholm can provide. This is done due to sustainability and the environmental approach as described earlier.

War materials

Different metals such, as steel is one of the most common materials used in war, this is among more used in the production of weapons. Steel does exist in different types for example stainless steel or weathering steel (COR-TEN steel). Buildings build in stainless steel can have the feature that they tend to reflect the sun in a way that can be irritating. From a long distance the reflection of sun can make the building more visible. Weathering steel can on the other hand make the building more invisible from a long distance. The rust red collar will make a building at Hammershus fall in to the surroundings and therefore not overtake the hierarchy between the buildings. Weathering steel does also have a disadvantage: "Using weathering steel in construction presents several challenges. Ensuring that weld-points weather at the same rate as the other materials may require special welding techniques or material. Weathering steel is not rustproof in itself. If water is allowed to accumulate in pockets, those areas will experience higher corrosion rates, so provision for drainage must be made." (Wikipedia, 2013b)

Another material connected to war is concrete. Concrete is well known as main materials in pillboxes. Concrete can appear in all kind of shapes and colours, and is a very common used building material.

Local materials

Bornholm has two characteristic main raw materials: granite and oak (Bjerregaard, 2013). Granite is a very heavy product, and granite from Bornholm appears in four types (Zurface, 2013). All four products have a tendency to appear uneven due to the appearance of different materials inside the granite. This uneven appearance can in some cases take away the attention from the rest of the room. For the avoiding that granite should be used together with even products such as a plain white surface. The oak is from the forest of Almindingen. Oak is a relatively hard type of wood and is therefore used for many kinds of purposes such as floors and columns. The colour is warm and bright (Trae, 2013).

Conclusion

With these information's in mind, the materials that will be used for the new visitor centre will be:

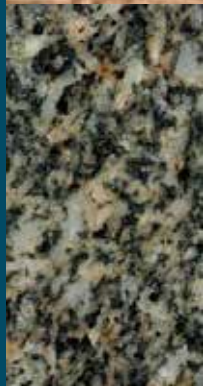
- Weathering steel due to it's ability to make a building fit in to the hierarchy. The disadvantage should be noticed in the design process.
- Concrete due to its relation to war and it's good qualities.
- Oak due to its relation to Bornholm and it's hardness and warm colour.

Granite is deselected due to its uneven appearance. At the site the existing walls already appears uneven, and the granite will therefore take some focus away from these walls.

Ill. 72 Weathering steel

Ill. 73 Pillbox

Ill. 74 Oak



Ill. 75 Granite

BE10

With the demands of, as far as possible to use natural ventilation as described on page 14, Be10 will be used to find out what use least energy mechanical or natural ventilation. Be10 is also used to see the overall energy consumption for the new visitor centre. Naturstyrelsen demands (page 14) that the energy performances for low energy class 2020 are followed, that is consumption at 25 kWh/m2 per year.

Be10 is not used until now, because the overall expression was related a lot to the history at the site, and was therefore decided at first. From here Be10 will help to change in the design if the energy frames are not observed.

Because of the earlier described yearly use from April until end October, a year in Be10 will have different minimums temperatures. The temperature in the visited period from April until end of October will be minimum 20 degrees Celsius (Calculated as summer in Be10). In the period from end October until start April (Calculated as winter in Be10) the visitor centre only has to be kept free of frost, the temperature will therefore be 5 degrees Celsius. In the following scheme I will write the essential data.

If nothing is mentioned, the material is dimensioned with Rockwool energy calculator (Rockwool, 2013) as follow:

- The original walls:	600 mm of granite wall, u-value=2,6
- New walls and roof:	100 mm concrete 645 kg/m3, 300 mm. Rockwool, 20 mm steel, u-value=1,2
- Foundation:	Concrete, Ψ W/mK = 0,4 (Bygningsreglementet, 7.6 stk.1, temperaturfaktor b=0,7 (SBI, 2013)
- Window frames:	W/mk = 0,06 (Bygningsreglementet, 7.6 stk.1)
- Windows	2 layer energy window u-value=1,3, a 2-layer window is selected because the visitor centre is closed in wintertime, and therefore it assumes that windows with very low u-value is not necessary.
- Ventilation:	Fo = 0,75 (SBI, 2013), winter ventilation 0,3 l/s, m2 , summer ventilation except restaurant 3,8 l/s, m2, summer ventilation restaurant 5,2 l/s m2 (DS 15251, 2007:34), injection temperature 18 degrees Celsius, n: vgv = 0,7 (Bygningsreglementet 8.3 stk. 6)
- Internal heat contribution:	4 W/m2 (SBI, 2013)
- Illumination:	Exhibition: 50 lux, min 2 W/m2, inst 2,5 W/m2, 1w/m2 for spotlight Rest of visitor centre: 200 lux, min 2 W/m2, inst. 10 W/m2 Automatic control
- Daylight factor:	The daylight factor is not calculated exactly, but if the rule of thumb from the building regulation mentioned earlier is used, to control if a decent lightning in the classrooms are created, there should be a window area equal to minimum 10 % of the floor area. At the same time the daylight factor comes from the window design phase which was defined on base of the illumination demands. With a classroom area of 147 m2 the window area should be 15 m2. In the model used in Be10 the window area is 27 m2 for the classroom, and the daylight factor is therefore above 2%. So in this regard the classrooms with the calculated windows is expected to create a comfortable classroom regarding to illumination. And as long as the real daylight factor is above the calculated the “real world” will turn out more positive than the world from Be10 regarding to energy use.

The calculation

The calculation is made with a room temperature set to minimum 20 degrees Celsius for the months from April to end of October and set to minimum 5 degrees Celsius for the months from November until the end of March. The detailed schemes for the calculations can be seen in appendix A.

Natural ventilation:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total energy frame (kWh/m²)	0,2	0,1	0,0	2,0	0,0	0,0	0,0	0,0	0,1	1,8	0,0	0,0
kWh/m2 used for ventilation												
MWh/m² used for heating	o,3	0,1	0,0	3,3	0,0	0,0	0,0	0,0	0,1	3,1	0,0	0,0

The total energy frame in total: 4,2 kWh/m2

kWh/m2 used for ventilation:
0 kWh used for ventilation because it is natural ventilated.

Total MWh/m2 used for heating: 6,9 MWh/m2

Mechanical ventilation:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total energy frame (kWh/m²)	1,2	1,1	1,2	1,7	2,1	3,2	3,6	3,3	1,4	1,7	1,1	1,2
kWh/m2 used for ventilation	0,2	0,2	0,2	0,2	1,1	1,8	2,0	1,8	0,7	0,2	0,2	0,2
MWh/m² used for heating	1,5	1,4	1,4	2,4	0,1	0,0	0,0	0,0	0,0	2,3	1,3	1,4

The total energy frame: 22,8 kWh/m2

Total kWh/m2 used for ventilation: 8,8 kWh/m2

Total MWh/m2 used for heating: 11,8 MWh/m2

If a comparison between the total energy frame for the natural ventilation and the mechanical ventilation is made. Both live up to 2015 energy frame but only the total natural ventilated building live up to the energy 2020 frame with a total use of 4,2 kWh/m2. The building as it is calculated therefor live up to the demands from the developer Naturstyrrelsen. If a deeper look in to the calculation to decide what use the least energy natural or mechanical ventilation is made. The natural ventilation shows a yearly use of 6,9 MWh/m2 for both the heating and the venting, while the mechanical ventilation uses 11,8 MWh/m2. The new visitor centre should therefore be a natural ventilated building, and this information is therefore carried on to both the design process and the BSim calculation in the exhibition room.

BSIM
- Calculation for the exhibition room

The BSim calculation is made on the exhibition room. The BSim calculation is used in the design process to find out what effect the original uninsulated walls have on the indoor climate, if the new walls is build on top of the old ones without covering the old. At the same time it is interesting to see what difference the uninsulated walls have on the energy use comparing with walls including isolation. BSim is also used to adjust to avoid overheating. Due to the thick wall to the south (40 centimeteres thicker than the other walls), it could be a possibility to use that thickness to create space within the wall, from where preheatet air can be let in to the exhibition room. If this solution is neede, will also be investigated.

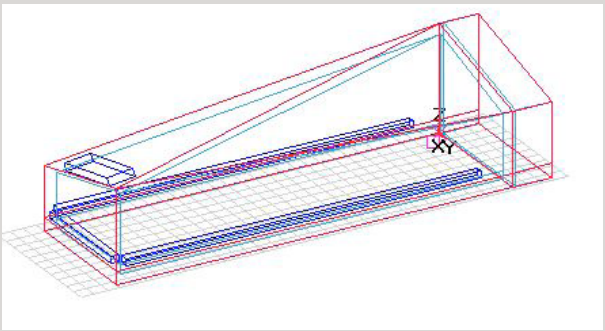
This scheme describes the data put in to BSim.

Time schedule:
a: Opening hours: April 1st.- October 31st., 8 am. - 6 pm.
b: Open period but closed off: may 1st. - september 30th., 6 pm. - 8 am.
c: Closed for winter: November 1.st - March 31st.

System	Description	Control	Schedule
People load	75 as 50 % loaded from 8 am. - 5 pm. 150 as 100% loaded 12 pm to 3 pm.		a
Lightning	Special lightning 1,9 W/m^2 (Ledon, 2013) Common lighting 1,4 W/m^2 50 lux, Neon tube energy (Mygreenlightning, 2013) Solar limit 0,2 kW	Light control Factor 1 Lower limit 0,1 kW Temp max 28°C	a
Ventilation	Input: 3,8 l/s/m^2(DS 15251) * 260$m^{2=}$ 988l/s = 0,988 m^3/s 630 Pa 0,7 Total eff 0,5 Part to air Output: 0,988 m3/s 630 Pa 0,7 Total eff 0,5 Part to air Recovery unit = 0, Because it is natural ventilation Heating coil = 0	Temp control: Part of nom flow: 1 Inlet temp 20 Heating set point 22 Cooling set pnt. 25	abc
Infiltration	Basic air change rate 0,7 TmpFactor 0, TmpPover 0,5, Windfactor 0 (SBI, 2013)	Full-load	a, b, c
Equiqment	20 Ipad minis of 5W each (Apple, 2013) Heat load: 0,1 kW Part to air: 0,5		a
Heating	Max power 5 kW Part to air 0,6 (SBI, 2013)	Open hours: Factor 1, Set power 20°C, Design temp -12°C, Min power 5 kW, Te min 17°C Open but closed: Factor 1, Set power 20°C, Design temp -12°C, Min power 5 kW, Te min 17°C Closed: Factor 1, Set power 5°C, Design temp -12°C, Min power 5 kW Te min 17°C	a b c

BSIM

The model as seen in BSim:



In BSim different models has been calculated, but all calculated models has the same outer shape. The change is instead done within the wall materials that were added. First a model with solid granite for the meter closest to the earth has been calculated. This wall symbolise the exhibition room with a combination of the existing walls of Hammershus combined with new isolated walls. The second model that was calculated was a model where all walls were insulated. This illustrate if the existing walls from the ruin was covered with insulation and combined with new insulated walls.
At first a investigation regarding room temperature was made, and this was held up against the building regulation even though that the building regulation on this subject is minded on residential buildings. Regarding temperature the building regulation writes following:

"Det termiske indeklima må ikke overskride 26°C, bortset fra nogle få timer i forhold til normalåret. For andre bygninger end boliger fastlægger bygherren antallet af timer pr. år, hvor indetemperaturen på 26°C ikke må overskrides. For boliger må 26°C ikke overskrides med mere end 100 timer pr. år. og 27 °C må ikke overskrides mere end 25 timer pr. år." (Bygningsreglementet, kap. 7.2.1 stk.13)

The calculation shows as seen in appendix B:
Exhibition room with uninsulated original walls:
Hours above 26: 73
Hours above 27: 25

Exhibition room with insulated walls:
Hours above 26: 98
Hours above 27: 42

From a perspective only regarding temperature it would therefore be the best to keep the existing walls uninsulated. This will with the minimum set ventilation create the least hours with temperatures over 26 and 27 degrees. The exhibition room does in this regard also respect the building regulation, while the room with insulation will create to many hours above 26 degrees for a room in a residential area.

If we look into how the humidity of the building is influenced we can see that the relative moisture % in the building wit the insulated walls reach 64,4 % in September and 60,8% in October as the only two months in the open period over 60% as recommended for a class two quality in DS 15151 (DS15251:p.38). For the building with the original walls reaches 65,9% for October, 60,5% for July and 60,3% for April. This means that the air quality, for the open period, regarding humidity is a bit better in the total insulated room than the room including original walls. For all year the rel. moist. reaches 67,6% for the building with original walls. The high humidity is caused the winter period with lower temperatures. For the building with insulated walls the humidity in general only reaches 66,5 %, because the isolation helps to keep out the moist in wintertime.

The overall energy use is for each room:
Exhibition room with uninsulated original walls: 5659,76
Exhibition room with insulated walls: 5521,35 kWh

The exhibition room with uninsulated original walls use a bit more due to the lack of insulation.

The influence of room to the south

If the wall thickness of the southern wall is taken advantage of, and a "room" from where the inlet air will be taken from is build, the numbers change a bit. The overall energy use will instead be:
The insulated building: 4848 kWh
The building with original walls: 4500 kWh

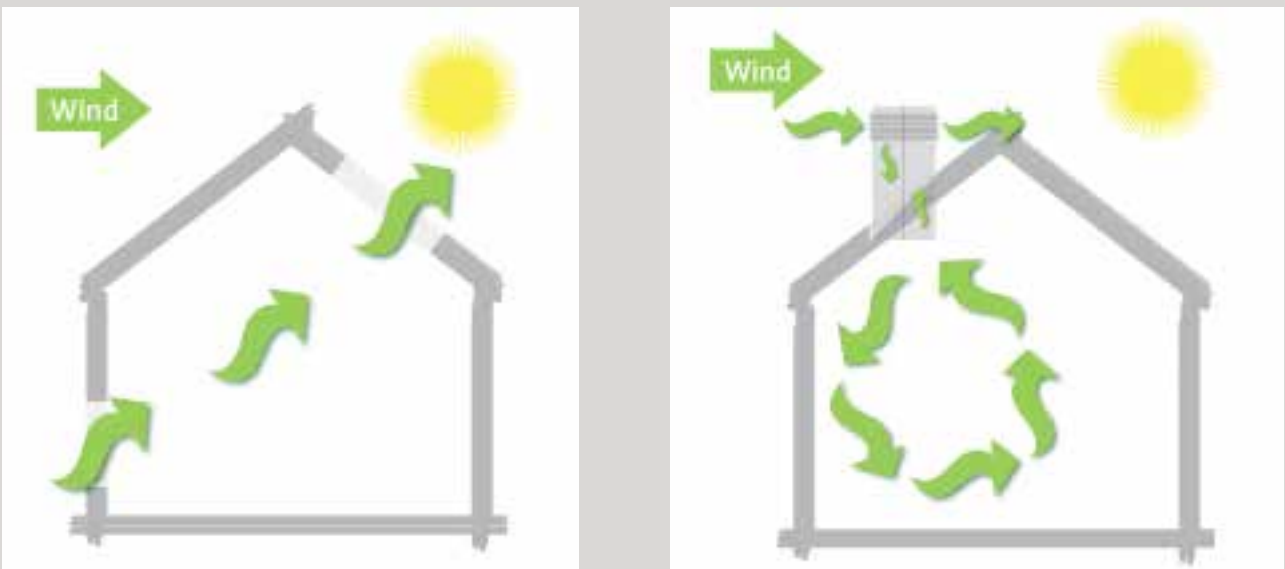
Further more the new heating room also increases the hours above 26 and 27 degrees a lot for both with and without insulation, and decreases the humidity. The exact number can be seen in appendix C

I all of these data is put together the most ideal design would be a building with isolated walls and natural ventilated with inlet from outside in the summer period and inlet from the heating room in the winter period. But because of the architectural demands a solution with the original walls is chosen and inlet from heating room in wintertime and inlet from outside in summertimer. This can be done because as seen in the calculation the advantage of isolation is not that big compared to the disadvantage of covering up the walls and in this way hide the history inside.

NATURAL VENTILATION

When the natural ventilation will be implemented it can be done in different ways. It would natural to it either by using the thermal buoyancy or by making the roof in to a so-called Windcatcher (Ventilation og indeklima, 2013). Especially in the exhibition room these technics is relevant due to the high room height. From an architectural point of view the natural ventilation could be integrated in to the roof facade in two ways. One possibility could be to make the weathering steel pierced, so that the fifth facade is kept homogeneous, another possibility is to make use of the windows in the ceiling, and let them open automatically. An example of this pierced facade can be seen on opposite page.
The natural ventilation has not been investigated more in this project, but when the building should be developed further it would be natural to calculate the if windows the ceiling is enough space to let out the air or if the pierced facade would be a better alternative.

The two examples of natural ventilation:

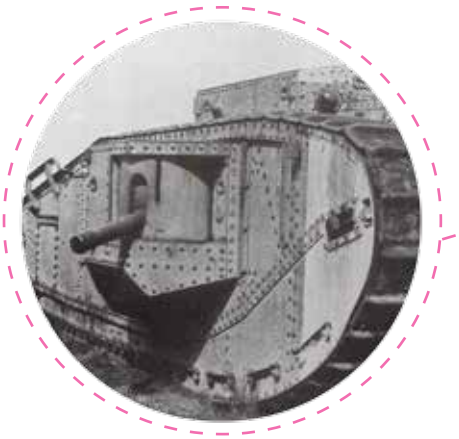


Ill. 76: Natural ventilation

Ill. 77: Natural ventilation 2

Presentation

THE CONCEPT



The spatial concept for this visitor centre is build around a design that relate to three equal factors which all influence on the visitor centre. It counts war, the historic perspective at the site and the ruin as it is today.

The war is illustrated by the steel from tanks and concrete from bunkers, and is a factor because of the history of Hammershus as a fortress and a major part in the fight with both the Swedish archbishop and the Lübechs. In the modern visitor centre "the war" is mainly defining the materials. From the outside the visitor centre is a tank watching out for enemies, and from the inside a bunker a and safe place to be.

The second factor, the historic perspective, has an impact on the details and the master plan of the building. The details is seen in the porthole windows and the watchman's path, and the orientation of the new building which orientate inwards as the original Hammershus

The third factor the ruin as it is today affects how the new visitors centre place it selves in the ruin and the landscape surrounding it.

All together they create a the new visitor centre at Hammershus.

ARRIVAL

By arrival the visitors will experience the building like this. The building will appear like a rebuild iteration of the original stables with the two low stable buildings and the higher barn in the middle, all having a modern iteration of the original saddle roof. By arrival the higher roof next to Blommetårnet will drag people to the visitor centre. The courtyard will despite of the new visitor centre appear original.

ENTRANCE

When visitors in the future will arrive they will use the old stable entrance to enter the visitor centre. By this visitors will experience one part of the history of the stables.

RECEPTION

When entering the reception visitors will experience a low-ceilinged room. From the double high room in the back the light will flow and drag visitor to experience the stunning view direct to the sun. For visitors the window in the ceiling will also function as a sundial, which cast its shadow on flow. While the visitors are entering the restaurant or getting information about Hammershus, they can experience contrast between the hard concrete walls and the soft wooden walls.

RESTAURANT

The restaurant is the place to be, for visitors who wants to enjoy a sunset together with a glass of wine. From the first floor restaurant it is possible to get a clear view to all of the ruin.

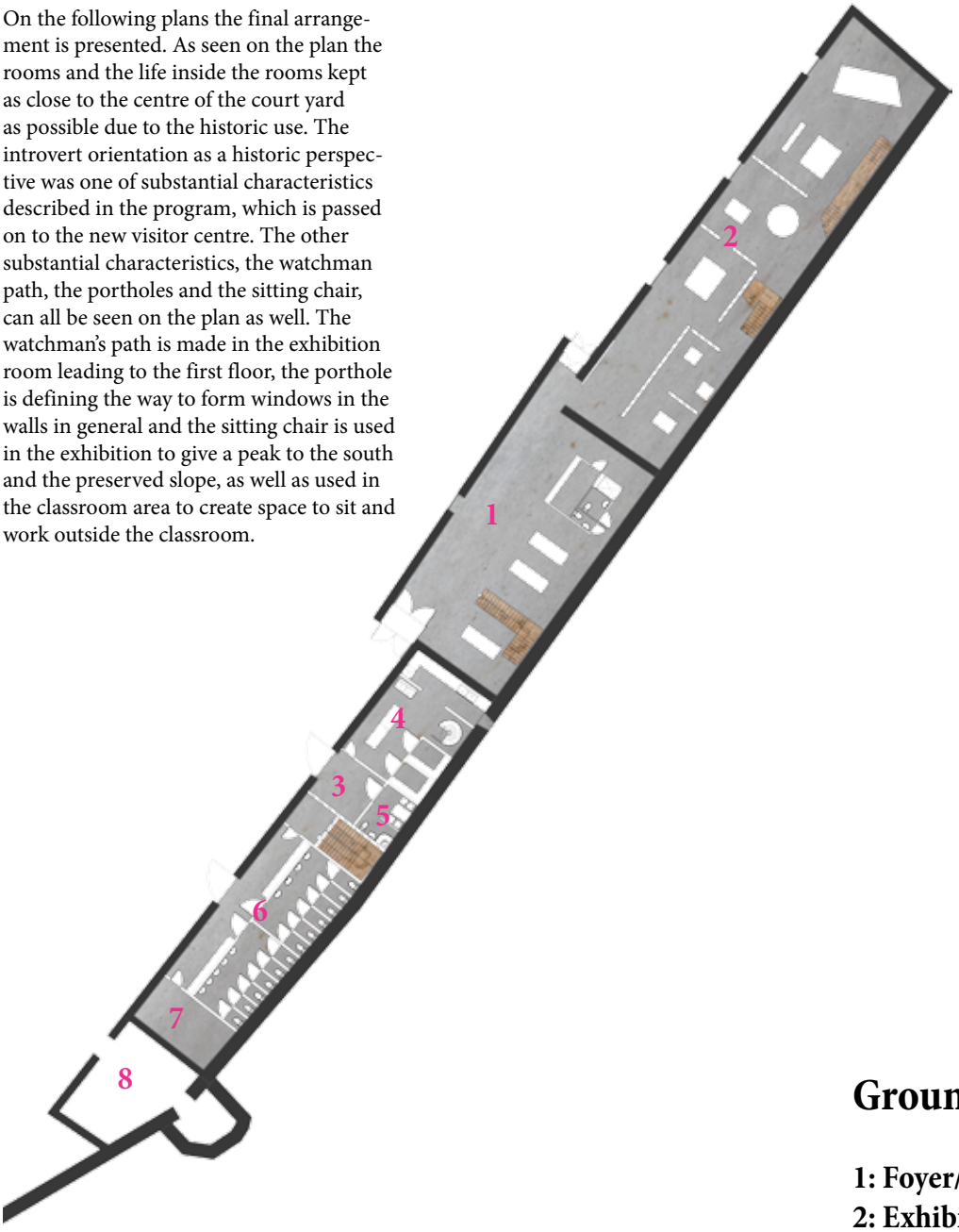
EXHIBITION

In the exhibition room the low windows and simplicity of the room will give the visitors the best conditions for acquaint themselves to the history of Hammershus. Despite of the models and the poster the visitor can also experience an iteration of the old watchman's path, a porthole and a traditional sitting chair. The concrete material will lead the thought pillboxes from Second World War at the same time the visitor will be reminded that Bornholm is island full rocks. Due to the small pieces of local quarried rocks within the concrete.


N

FLOOR PLANS

On the following plans the final arrangement is presented. As seen on the plan the rooms and the life inside the rooms kept as close to the centre of the court yard as possible due to the historic use. The introvert orientation as a historic perspective was one of substantial characteristics described in the program, which is passed on to the new visitor centre. The other substantial characteristics, the watchman path, the portholes and the sitting chair, can all be seen on the plan as well. The watchman's path is made in the exhibition room leading to the first floor, the porthole is defining the way to form windows in the walls in general and the sitting chair is used in the exhibition to give a peak to the south and the preserved slope, as well as used in the classroom area to create space to sit and work outside the classroom.

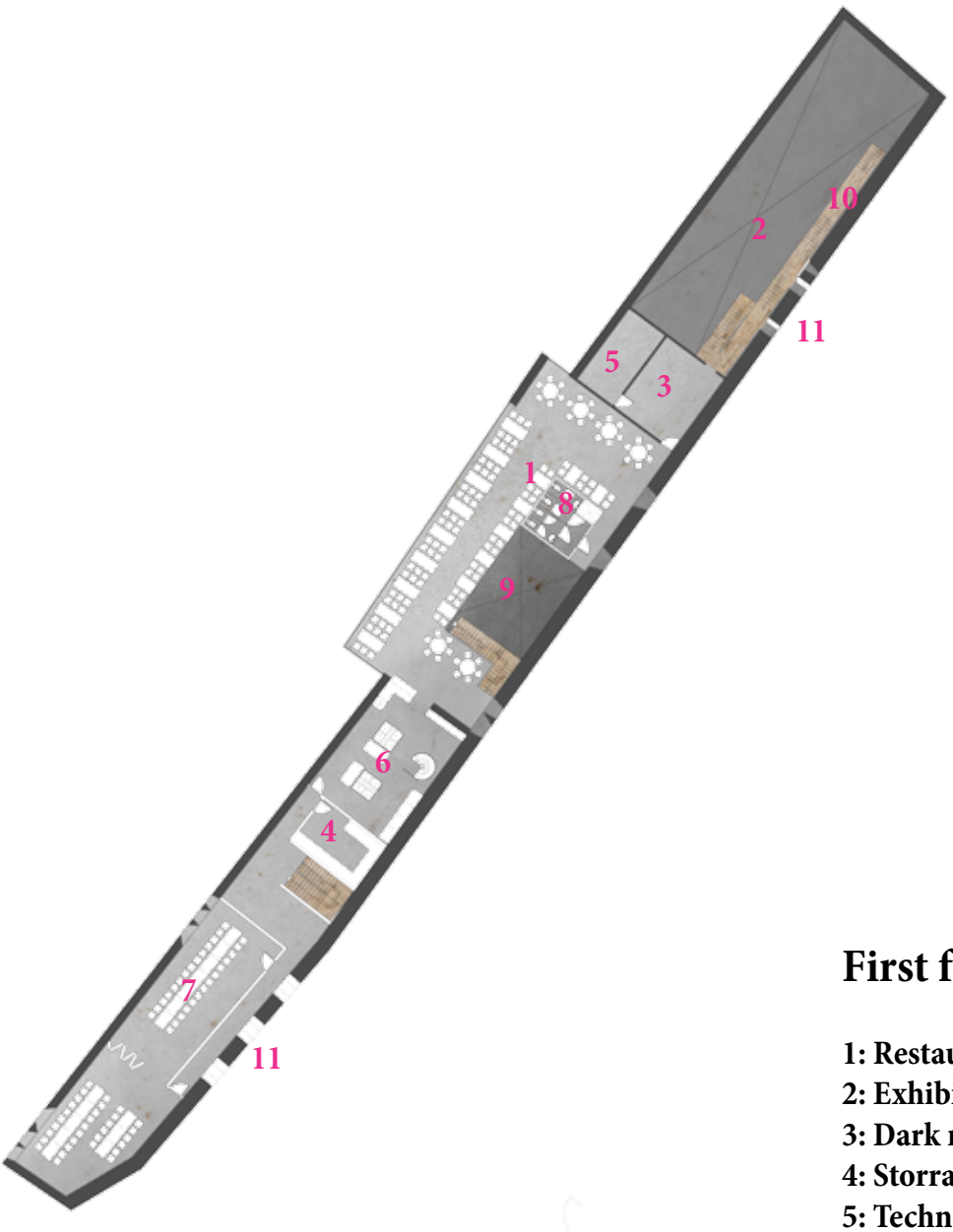


N

1:500

Ground floor

1: Foyer/reception
2: Exhibition
3: Storrage for restaurant
4: Kitchen
5: Changing room for staff
6: Toilets and lockers
7: Storrage
8: Roofed area in case of rain



N

1:500

First floor

1: Restaurant
2: Exhibition at ground level
3: Dark room for exhibition
4: Storrage
5: Technical room
6: Kitchen
7: Classrooms
8: Toilets
9: Opening to reception
10: Watchmans path
11: Sitting chair area

N

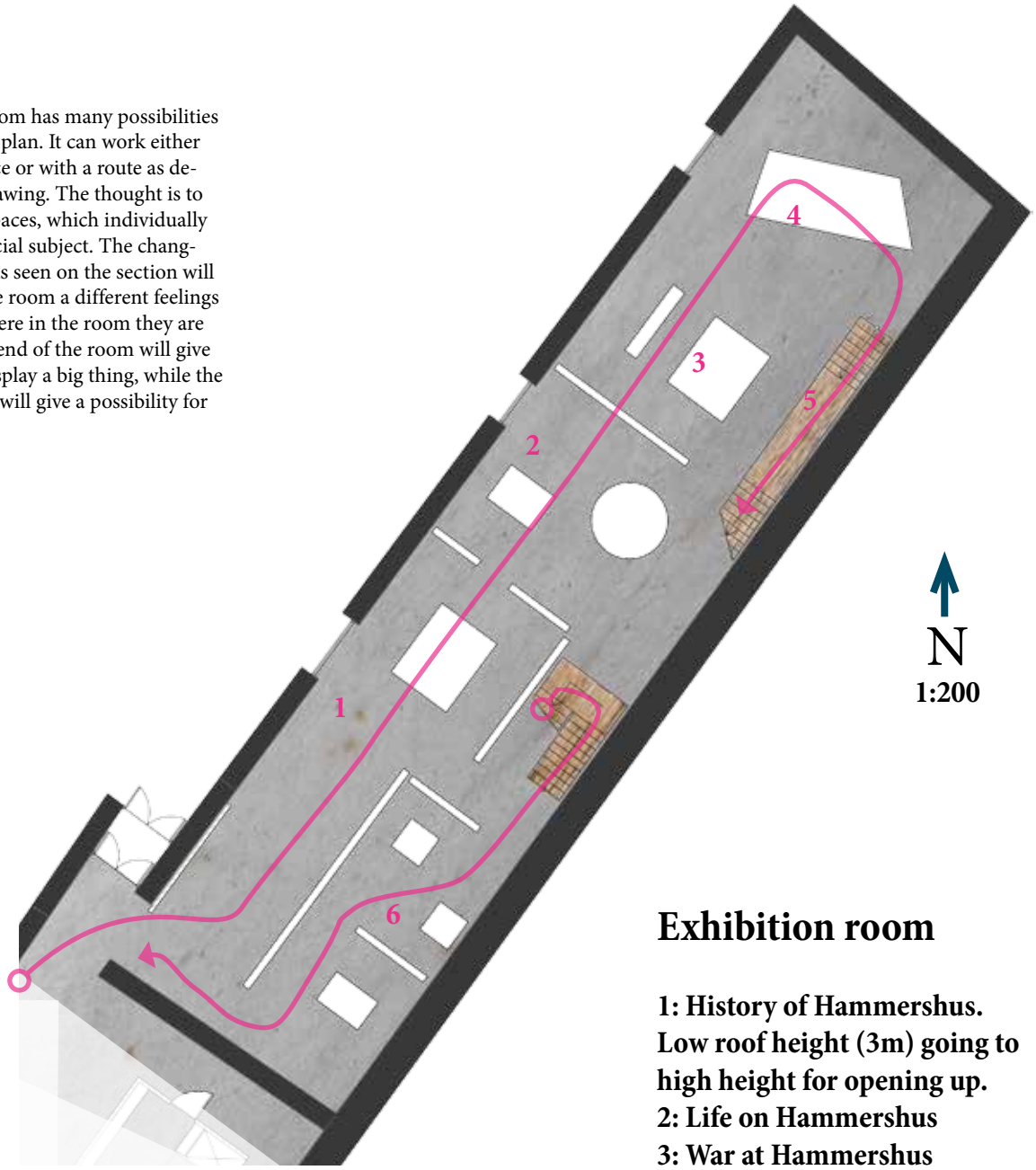
1:500

Roof

The roof has very few and well placed roof windows. They are all placed just next to wall underneath so it will give a light, which can be followed down the walls inside the building. The material is the same as the walls. This is done to create a more solid building, with a more simple expression. At the same time the roof has to function as a fifth facade, when the balcony on the earlier described site two is build.

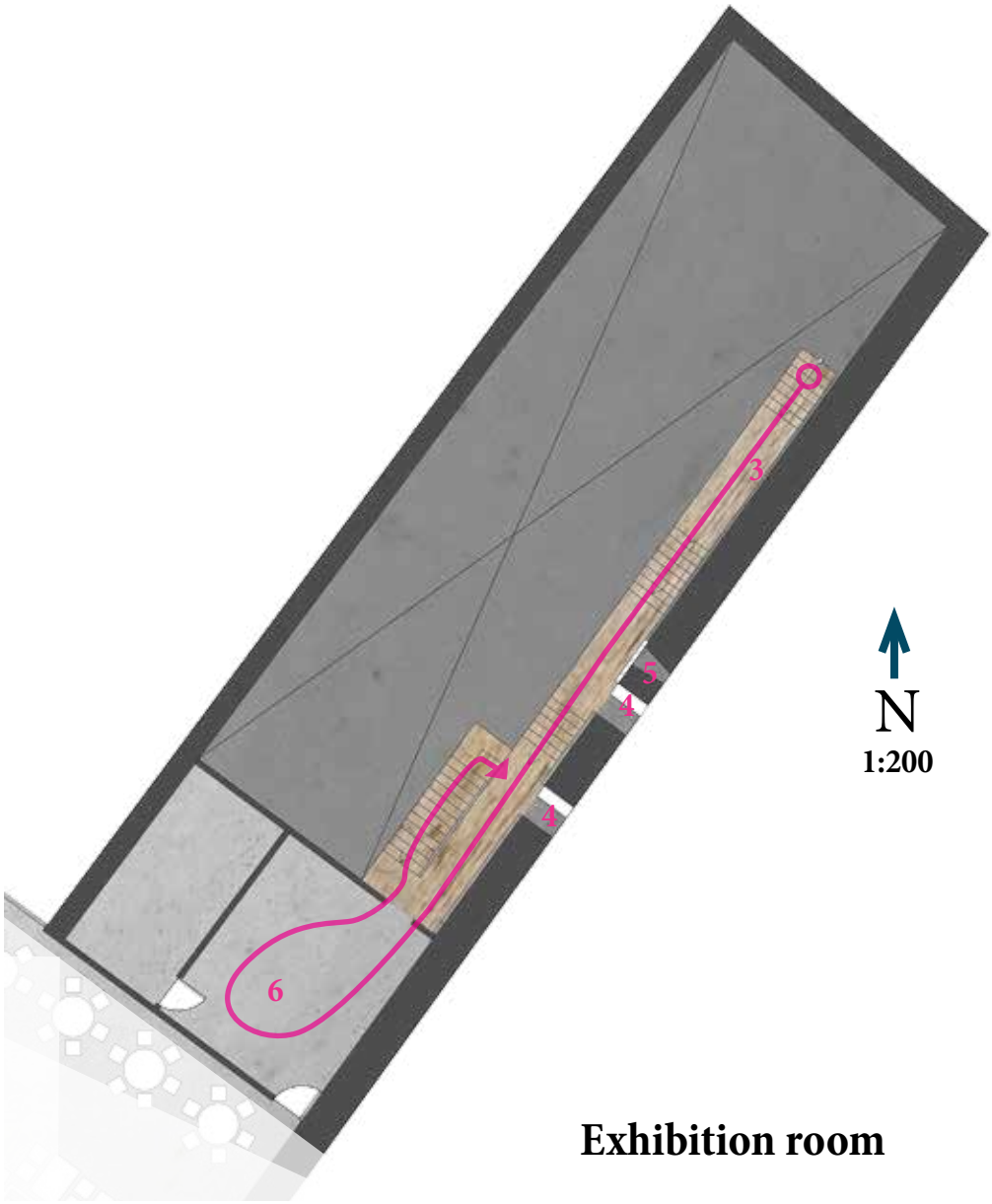
EXHIBITION

The exhibition room has many possibilities and with its open plan. It can work either as a big open space or with a route as described on the drawing. The thought is to create different spaces, which individually can present a special subject. The changing room height as seen on the section will give visitors of the room a different feelings depending on where in the room they are placed. The high end of the room will give a possibility to display a big thing, while the low room height, will give a possibility for immersion.



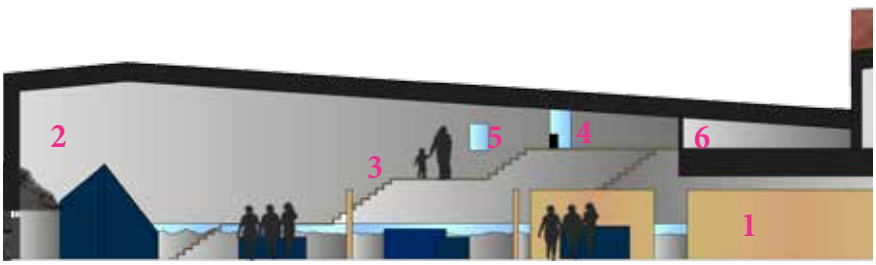
Exhibition room

1: History of Hammershus. Low roof height (3m) going to high height for opening up.
2: Life on Hammershus
3: War at Hammershus
4: Highest room height (6m) for exhibition of Trebuchet size 1:1
5: Stairs to first floor exhibition
6: Low-ceilinged area for exhibition of archaeological objects. The low-ceiling give a bette opportunity for absorption.



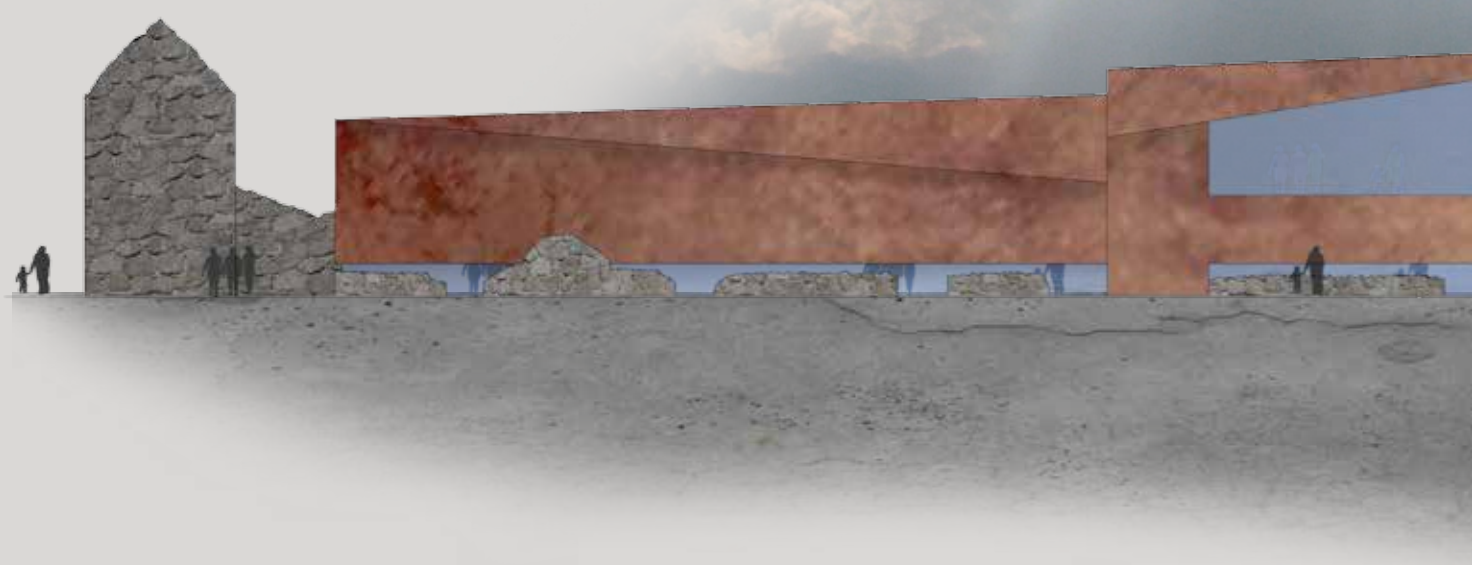
Exhibition room

1: Low-ceilinged area for for welcome and archeological objects. The low ceilinged area give better opportunity for absorption. (3m)
2: Highest roof hight for exhibition of big things. (6m)
3: Stairs to first floor exhibition. (Wacthmans path)
4: Sitting chair
5: Portholes
6: Dark room for movies

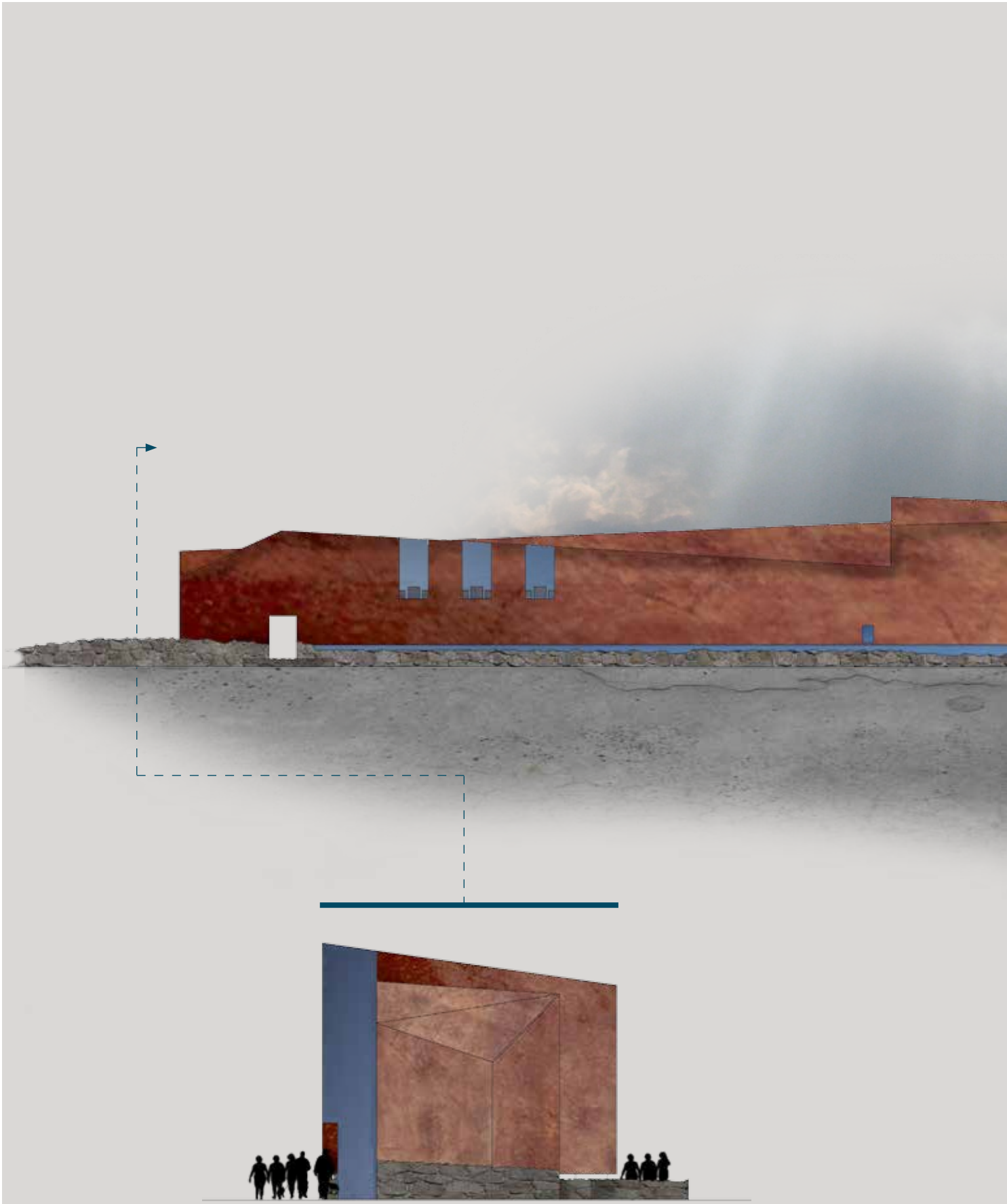


THE FACADES

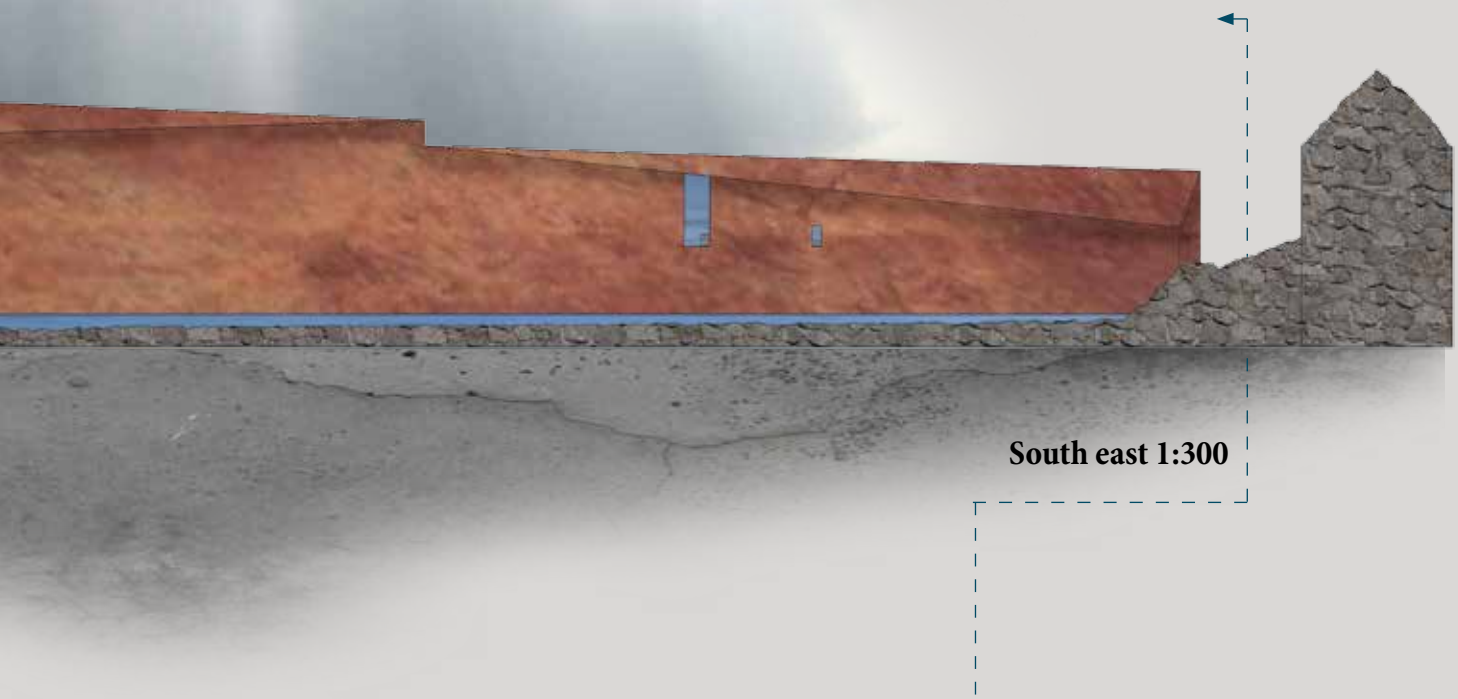
The facades are illustrating the clash between original walls and new walls. The new wall has a calm surface, while the old boulder wall is more noisy. The facade is also clearly illustrating the history of the closed stables in the sides and the more open barn in the middle. In a historic perspective the northwest facade opens up to the courtyard compared to the more closed southeast facade that closes of for projection against enemies. The room height of the exhibition room to the east end against Blommetårnet also haves a height which fall in to the hierarchy and keeps Blommetårnet as the most important thing.



North west 1:300



South wesat 1:200



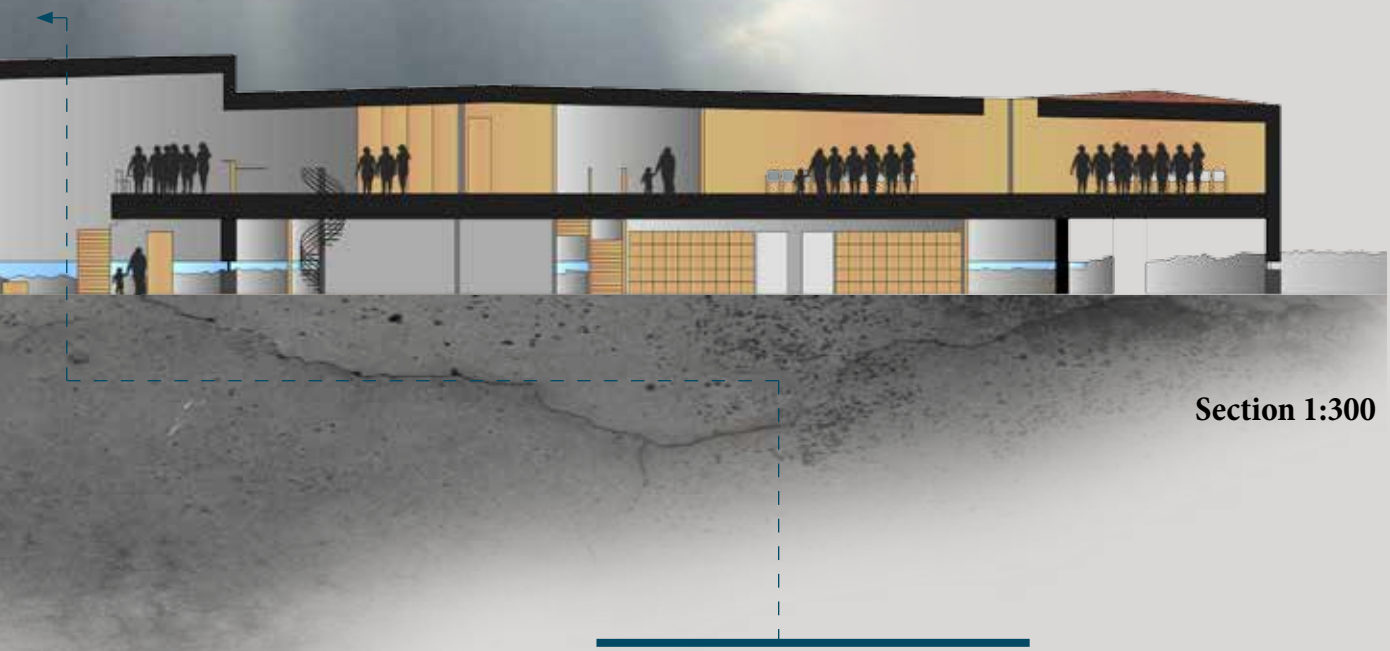
South east 1:300

North east 1:200

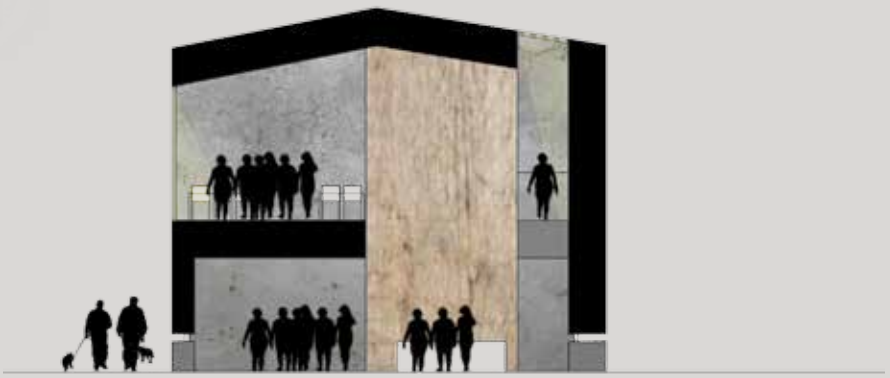
CROSS-SECTIONS

In the section watchman's path, the port-holes and sitting windows from the original Hammershus gets visible in the exhibition room. The section also illustrates how the exhibition room gets higher towards the end, where a trebuchet in size 1:1 or other big things could be displayed. In the foyer the double high room is exposed.

Section 1:200



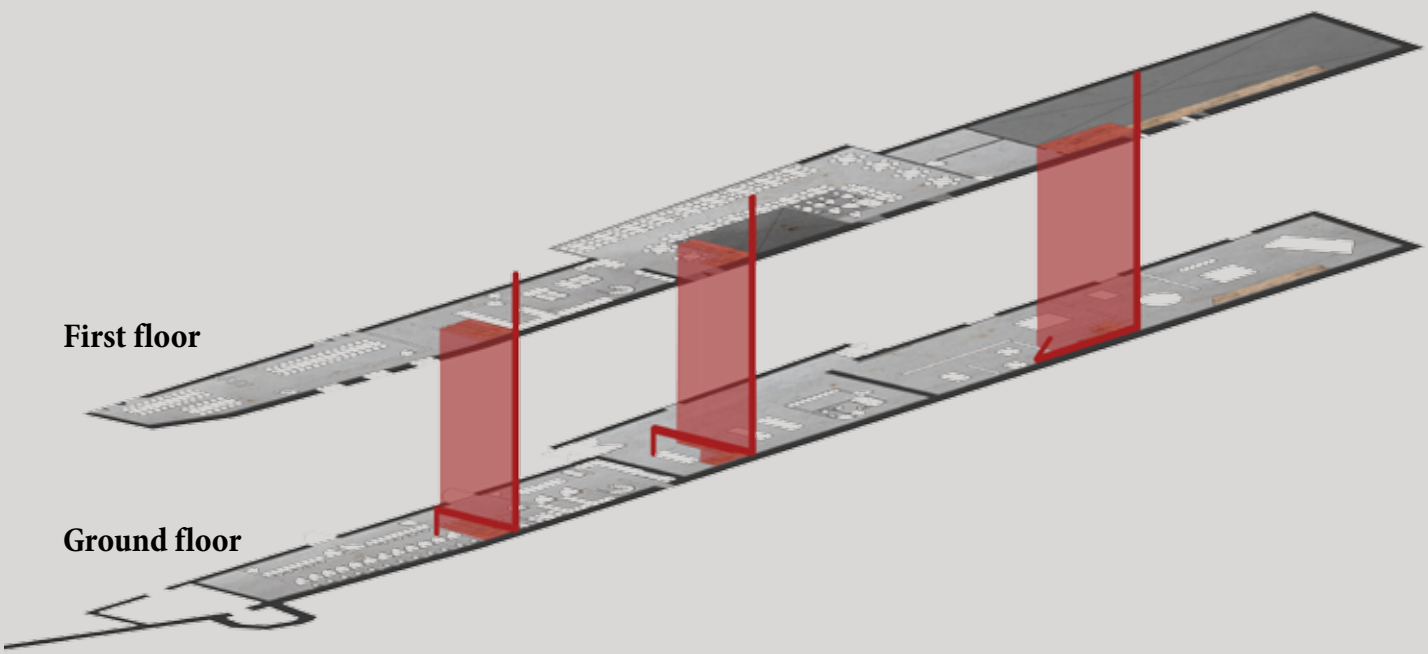
Section 1:300



Section 1:200

FIRE PLANS

In the process of designing the new visitor centre the design has to make the nev visitor centre respect the building restrictions due to fire exits. These restrictions demand at least two independent firedoors and a maximum of 25 meters to th nearest escape (Bygningsreglementet, 5.2 stk. 6). With the fire escapes as the illustration on this page the building live up to the demands, however the most far away corner in the exhibition room is 30 meters away, but because the building is excused from Buildregulatives as earlier described, this is not a problem. However it coul be worth corcerning if the former doors in the middel of the wall in the stable can be transformed in to fire exist. This could maybe be done with a hammer installed next to the windows.



Ill. 55 The fireplan

CONCLUSION

At the top of the rock where Hammershus once enthroned and afterwards was abandoned and forgotten a new visitor centre has been designed within this project. The visitor centre should give Hammershus another golden age. With the location in the middle of the ruin as part of Mantelgården the exhibition will be placed where it belongs: in the same buildings in which the history of Hammershus unfolded.
When visitors in the future arrive at Hammershus they will experience the courtyard and Mantelgården as it looked before it was abandoned, including the experience of the exact location at the top of the rock with the outer wall almost falling down the slope. At the same time the castle's clear hierarchy, with the new visitor centre placed in the stables and Mantelgården's tower enthroning as the ruin's highest point, is maintained. When the visitors then enter the visitor centre they will in a modern way again experience the history of the site, both in terms of the exhibitioin, but also in terms of the substantial characteristics, that have been integrated to the new building.
The challenge has been to create a natural fusion between the old and the new in which the final expression leaves space for both the new and the old story. The outcome unfolded in this project makes it impossible for future visitors to overlook that they find themselves in an old ruin along with a clear experience of the new building. The original walls and spatialities are maintained and new walls, surrounding these spatialities forming a new room demands, have been designed.
Beside the contrasts between old and new, a contrast between the hectic space and the possibility for contemplation has been a focal point. During the whole process, communication has been a top priority concerning the preparation of spatialities for the exhibition, in which the history of Hammershus should be communicated, and in the story formed by the new building. These considerations have influenced the design of the windows, the size of doors and choice of materials.
The vision has been to create the transformation from a ruin into a modern sensory space that both directly and indirectly can communicate the history of Hammershus and at the same time a building that live up to the sustainable demands from page 10.
Furthermore, the demands from Naturstyrelsen was to both create an 'invisible' visitor centre that would not mar the area and eliminate the attention from the surrounding nature, and at the same time create a space that would be able to accommodate many different functions for many different users. The demands for a sensory space, sustainability and different functionalities are thus fulfilled.

REFLECTION

The reflection is divided in to different which each of them elaborate on the given subject. The subjects are many, but here I have chosen three of the most essential ones.

Placement
By placing the visitor centre at the top of Mantelgården the challenges of the design process have been many – this includes the transformation from an old ruin into a new building, the spatialities of the ruin and the lack of isolation. Furthermore, two challenges are obviously: The preservation of Hammershus, and how the visitor centre would work in reality. Hereby meant all the challenges that come together with a building placed in such fragile and exposed environment such as getting materials and water to the site. For a master project like this it gives a dimension more to the project that you in many ways have to relate to a given context that limit you compared to the real project. But even though it gave many problems it also gave me many new dimensions to my thoughts on architecture.

Sustainability
Sustainability can, as earlier described, be worked on in many ways. In this project I have had a technical approach to find out how the ventilation should be and how the clash with the old wall should look like, but it could also have been interesting to use it to give the dimensions of the windows to a greater extent than it did. A big effect that did limit the use of Be10 and BSim was the placement in the ruin. For me it meant, that I did use a lot of time to work with communication of the history and the relation to the existing buildings in the ruin and in that part BSim did not play a big role, so when it came to the actual building, the possibilities of changes was more reduced.

A further dimension
If an iteration more of the building should have been made, it could be interesting to look in to how the new visitor centre to a greater extend will use the surroundings. Herby not meant only the tower but also the rest of the buildings. In this the new visitor centre and the existing ruin could supplement each other even more.

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ILLUSTRATION LIST

Illustrations not named here or numbered in the report are either made by me or from Google Earth.

Ill. 2: A sign, lokaliseret 27.09.13 på:
http://www.flickr.com/photos/77231052@N00/5847164192/in/photolist-9UGfcJ-9UG84S-9UFYo3-9UD8LT-9UG14Y-9UDk1k-9UD7Yv-9UDca4-9UDqHZ-9UDsGa-9UD54F-9UFXuW-9UDiKV-9UGkwA-9UGg4j-9UD6YV-9UG9oU-9UDnfz-9UDbAk-9UDcUc-9UFXms-9UFZh3-9UDnF8-9UGhmd-9UGhSY-9UD2Zg-9UG7sd-9UFXLE-9UDfV8-9UDdmT-9UGfUy-9UDfLk-9UDgWv-9UFSho-9UDa7v-9UG2FU-9UG5dy-9UG7Bb-9UDh4Z-9UDkVv-9UD1Qc-9UD4Ca-9UG9yd-9UGhtj-9UD1dM-9UG6uS-9UG7i5-9UD9ex-9UDhSD-9UDiAz-9UDj3r

Ill. 5: Bornholm natur, lokaliseret 27.09.13 på:
http://www.flickr.com/photos/33716148@N05/3646491279/in/photolist-6yedPi-8kRmSo-7pERBv-7pJMPN-7pJMhS-7pJXNb-7pJEfb-7pEKXM-b2fv2X-dXmBHi-dXmBUa-dXshC9-dXsir5-dXsijh-dXmBQD-dXsidm-dXmBvv-dXshzy-dXmBCM-dXmBic-dXmBGR-dXmBMv-dXsi8W-dXsieJ-dXmBBX-dXsioE-dXshQC-dqX-eE4-dqXrTZ-dqXtD7-7pJyQG-7pJPk1-7pEVbc-7pJAZL-7pJNfQ-7pJu8f-7pJvTG-7pJzWq-7pEydZ-7pEBkK-2rdZe8-8iSRn7-M3Dbc-7pJEHG-5E1T2x-M3DpX-M3Dex-M3wPd-Nwzd3-ay5R2E-ay38HF

Ill. 6: Bornholm, screenshot taget 27.09.13 på Google Earth

Ill. 7: Mantelgaarden, half round tower, lokaliseret 27.09.13 på:
http://www.sns.dk/fortidsm/netpub/hammershus/illust/side22.jpg

Ill. 8: Hammershus as it assumed to look like before it was abonded, lokaliseret 27.09.13 på:
http://www.sns.dk/fortidsm/netpub/hammershus/illust/akvarel.jpg

Ill. 13: Slotsgaardens Café lokaliseret 30.10.13 på:
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Ill. 15 & 28: Bird's eye view, lokaliseret 27.09.13 på:
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Ill. 16: Hammershus, lokaliseret 27.09.13 på:
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Ill. 20-22: Google earth, lokaliseret 01.10.13. på:

Ill. 23: Tower, lokaliseret 01.10.13. på:
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Ill. 24: Sun diagram, Lokaliseret 03.10.13 på:
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Ill. 25: Rain diagram, lokaliseret 03.11.13 på:
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Ill. 37: Lade og agerrum, lokaliseret 27.09.13 på:
http://www.flickr.com/photos/anecia/2686329075/sizes/o/

Ill. 38:Lade og ageerrum 2, lokaliseret 27.09.13 på:
http://www.flickr.com/photos/roesen/2713789659/sizes/o/

Ill. 39: Siddevindue, lokaliseret 27.09.13 på:
http://www.flickr.com/photos/bachmic/7453227608/sizes/o/

Ill 43, Shadow, lokaliseret 27.09.13 på:
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Ill. 44: Castelvechio, lokaliseret 27.09.13 på:
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Ill. 45: Hamar Bispegård, lokaliseret 27.09.13 på:
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Ill. 46: Koldinghus, lokaliseret 27.09.13 på:
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Ill. 48: Vision, lokaliseret 03.11.13 på:
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Ill. 66: BIG - Blåvand bunker museum, lokaliseret 27.09.13 på:
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Ill. 72: Weathering steel, lokaliseret 27.09.13 på:
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Ill. 73: Bunker, lokaliseret 27.09.13 på:
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Ill. 74: Oak, lokaliseret 27.09.13 på:
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Ill. 75: Zurface, 2013, Granite, lokaliseret 23.11.13 på:
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Ill: 76: Natural ventilation. lokaliseret 04.12.13 på:
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Ill. 77: Natural ventilation 2. lokaliseret 04.12.13 på:
http://static.panoramio.com/photos/large/9130334.jpg

APPENDIX A

Calculation: Natural ventilation 5° Celsius:

Model: Hammershus speciale 2	SBi Beregningskerne 6, 11, 11, 24												
Be10 resultater: Hammershus													
Energibehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Varme	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	20,90
El til bygningsdrift	0,26	0,23	0,26	0,25	1,62	2,55	2,90	2,60	1,08	0,26	0,25	0,26	12,50
Overtemperatur i rum	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Samlet energibehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
BR 2010	2,78	2,53	2,68	2,43	5,67	7,78	8,65	7,91	4,21	2,36	2,46	2,69	52,16
kWh/m²	1,9	1,8	1,9	1,7	3,9	5,4	6,0	5,5	2,9	1,6	1,7	1,9	36,2
Lavenergibyggeri 2015	2,35	2,14	2,27	2,07	5,34	7,50	8,37	7,63	3,90	2,02	2,10	2,28	47,98
kWh/m²	1,6	1,5	1,6	1,4	3,7	5,2	5,8	5,3	2,7	1,4	1,5	1,6	33,3
Byggeri 2020	1,74	1,59	1,69	1,53	3,89	5,44	6,06	5,53	2,85	1,49	1,55	1,69	35,05
kWh/m²	1,2	1,1	1,2	1,1	2,7	3,8	4,2	3,8	2,0	1,0	1,1	1,2	24,3
Varmebehov. Ekstern forsyning til bygning													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Kedel/fjernvarme	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	20,90
Gasstrålevarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Gasvandvarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Køling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	20,90
kWh/m²	1,5	1,4	1,4	1,3	1,1	1,0	1,0	1,0	1,1	1,2	1,3	1,4	14,5
Elbehov. Ekstern forsyning til bygning. Bygningsdrift													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Centralvarmeanlæg	0	0	0	0	0	0	0	0	0	0	0	0	0
Varmt brugsvand	0	0	0	0	0	0	0	0	0	0	0	0	0
Ventilationsanlæg	253	229	253	245	1615	2546	2899	2598	1073	253	245	253	12461
Kedel/fjernvarme	4	3	4	4	4	4	4	4	4	4	4	4	44
Varmepumpe	0	0	0	0	0	0	0	0	0	0	0	0	0
Solvarme	0	0	0	0	0	0	0	0	0	0	0	0	0
Rumopvarmning	0	0	0	0	0	0	0	0	0	0	0	0	0
Dec. elvandvarmere	0	0	0	0	0	0	0	0	0	0	0	0	0
Køling	0	0	0	0	0	0	0	0	0	0	0	0	0
Belysning	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt til bygningsdrift	257	232	257	249	1619	2549	2902	2602	1076	257	249	257	12505
kWh/m²	0,2	0,2	0,2	0,2	1,1	1,8	2,0	1,8	0,7	0,2	0,2	0,2	8,7
Elbehov. Ekstern forsyning til bygning. Andet elforbrug													

kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Anden belysning	112	101	112	108	112	108	112	112	108	112	108	112	1314
Apperatur	1875	1693	1875	1814	1875	1814	1875	1875	1814	1875	1814	1875	22075
I alt til andet	1986	1794	1986	1922	1986	1922	1986	1986	1922	1986	1922	1986	23389
kWh/m²	1,4	1,2	1,4	1,3	1,4	1,3	1,4	1,4	1,3	1,4	1,3	1,4	16,2
Elbehov. Ekstern forsyning til bygning. Samlet elbehov													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Bygningen	2243	2026	2243	2171	3605	4472	4889	4588	2999	2243	2171	2243	35894
Solcelleydelse	0	0	0	0	0	0	0	0	0	0	0	0	0
Vindmølleydelse	0	0	0	0	0	0	0	0	0	0	0	0	0
Resulterende elbehov	257	232	257	249	1619	2549	2902	2602	1076	257	249	257	12505
El til opvarmning	0	0	0	0	0	0	0	0	0	0	0	0	0
El til andet end opvarmning	257	232	257	249	1619	2549	2902	2602	1076	257	249	257	12505
Rumopvarmning, Varmebehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
I rum	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Vent. varmefl.	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	20,90
Rørtab	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	20,90
I alt, kWh/m²	1,5	1,4	1,4	1,3	1,1	1,0	1,0	1,0	1,1	1,2	1,3	1,4	14,5
Rumopvarmning, Dækning af varmebehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Kedel/fjernvarme	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	20,90
Solvarmeanlæg	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Varmepumpe	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
El-rumopvarmning	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
El-VF i ventilationsanlæg	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Brændeovne mm.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	20,90
Varmt brugsvand, Varmtvandsbehov													
m³	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Samlet forbrug	12,2	11,0	12,2	11,8	12,2	11,8	12,2	12,2	11,8	12,2	11,8	12,2	144,0
Varmt brugsvand, Forsyning													
m³	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Centralanlæg	12,2	11,0	12,2	11,8	12,2	11,8	12,2	12,2	11,8	12,2	11,8	12,2	144,0
Decentrale elvarmere	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Decentrale gasvarmere	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I alt	12,2	11,0	12,2	11,8	12,2	11,8	12,2	12,2	11,8	12,2	11,8	12,2	144,0

Varmt brugsvand, Varmebehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Central VVB	0,64	0,58	0,64	0,62	0,64	0,62	0,64	0,64	0,62	0,64	0,62	0,64	7,56
Dec. elvarmer	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Dec. gasvarmer	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Opvarmning i alt	0,64	0,58	0,64	0,62	0,64	0,62	0,64	0,64	0,62	0,64	0,62	0,64	7,56
Tab central VVB	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Tab tilslutningsrør til VVB	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
VBV rørtab	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Tab dec. elvandvarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Tab dec. gasvandvarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Tab i alt	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	0,64	0,58	0,64	0,62	0,64	0,62	0,64	0,64	0,62	0,64	0,62	0,64	7,56
kWh/m²	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	5,3
Varmt brugsvand, Dækning af varmebehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Kedel/fjernvarme	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Solvarmeanlæg	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Varmepumpe	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
El-opv. af central-VVB	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
El-tracing af VBV rør	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Dec. elvandvarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Dec. gasvandvarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Elbehov i varmeanlæg													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Direkte rumopv.	0	0	0	0	0	0	0	0	0	0	0	0	0
Pumper	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Elbehov i varmtbrugsvandsanlæg													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
El-opv. af central-VVB	0	0	0	0	0	0	0	0	0	0	0	0	0
El-tracing af VBV rør	0	0	0	0	0	0	0	0	0	0	0	0	0
Ladekredspumpe	0	0	0	0	0	0	0	0	0	0	0	0	0
Cirkulationspumpe vbv	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Elbehov i ventilationsanlæg													

kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Varmeflader	0	0	0	0	0	0	0	0	0	0	0	0	0
Ventilatorer	253	229	253	245	1615	2546	2899	2598	1073	253	245	253	12461
I alt	253	229	253	245	1615	2546	2899	2598	1073	253	245	253	12461
kWh/m²	0,2	0,2	0,2	0,2	1,1	1,8	2,0	1,8	0,7	0,2	0,2	0,2	8,7
Kedel/fjernvarmeveksler, Varme													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Ydelse	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	20,90
Forbrug	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	20,90
Udnytteligt varmetab	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Virkningsgrad	100	100	100	100	100	100	100	100	100	100	100	100	100
Kedel/fjernvarmeveksler, Elbehov													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Brænder, kWh	0	0	0	0	0	0	0	0	0	0	0	0	0
Automatik, kWh	4	3	4	4	4	4	4	4	4	4	4	4	44
I alt	4	3	4	4	4	4	4	4	4	4	4	4	44
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Varmepumpe, Varme													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Ydelse, Rumopv.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Ydelse, VBV	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Dækningsgr. Rumopv.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Dækningsgr. VBV	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Varmepumpe, Elbehov													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Elbehov, rumopv.	0	0	0	0	0	0	0	0	0	0	0	0	0
Elbehov, stb. rumopv.	0	0	0	0	0	0	0	0	0	0	0	0	0
Elbehov, VBV	0	0	0	0	0	0	0	0	0	0	0	0	0
Elbehov, stb. VBV	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Solvarmeanlæg, Varme													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Ydelse, Rumopv.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Ydelse, VBV	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Dækningsgr. Rumopv.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Dækningsgr. VBV	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	

Solvarmeanlæg, Elbehov													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Pumpe	0	0	0	0	0	0	0	0	0	0	0	0	0
Automatik	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Elbehov til belysning. Indgår i bygningens ydeevne													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Almen i brugstiden	4520	4082	3106	2185	1693	1638	1693	1975	2732	4520	4374	4520	37038
Alm. st.-by udenf. brug	0	0	0	0	0	0	0	0	0	0	0	0	0
Arbejdsbelysning i brugstid	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	4520	4082	3106	2185	1693	1638	1693	1975	2732	4520	4374	4520	37038
kWh/m²	3,1	2,8	2,2	1,5	1,2	1,1	1,2	1,4	1,9	3,1	3,0	3,1	25,7
Elbehov til belysning. Anden belysning													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
I brugstiden	112	101	112	108	112	108	112	112	108	112	108	112	1314
Natforbrug	0	0	0	0	0	0	0	0	0	0	0	0	0
Parkeringskældre mv	0	0	0	0	0	0	0	0	0	0	0	0	0
Udelys	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	112	101	112	108	112	108	112	112	108	112	108	112	1314
kWh/m²	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,9
Elbehov til apperatur													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Apperatur	1875	1693	1875	1814	1875	1814	1875	1875	1814	1875	1814	1875	22075
Natforbrug, apparatur	0	0	0	0	0	0	0	0	0	0	0	0	0
Særligt app. i brugstiden	0	0	0	0	0	0	0	0	0	0	0	0	0
Særligt app. altid	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	1875	1693	1875	1814	1875	1814	1875	1875	1814	1875	1814	1875	22075
kWh/m²	1,3	1,2	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	15,3
Solceller og vindmøller													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Samlet el-behov	2132	1925	2132	2063	3494	4364	4777	4477	2891	2132	2063	2132	34580
Solceller	0	0	0	0	0	0	0	0	0	0	0	0	0
Vindmøller	0	0	0	0	0	0	0	0	0	0	0	0	0
Samlet ydelse	0	0	0	0	0	0	0	0	0	0	0	0	0
Balance	-2132	-1925	-2132	-2063	-3494	-4364	-4777	-4477	-2891	-2132	-2063	-2132	-34580
Overskud	0	0	0	0	0	0	0	0	0	0	0	0	0

Ydelsesjustering	0	0	0	0	0	0	0	0	0	0	0	0	0
Solceller, indregnet	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Vindmøller, indregnet	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Nettovarmebehov i rum													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Varmetab	2,50	2,62	0,74	-2,30	-6,93	-9,57	-11,01	-10,85	-7,64	-5,17	-1,68	0,90	-48,39
Solindfald	0,83	1,52	2,77	4,48	6,16	6,35	6,13	5,01	3,39	1,88	0,92	0,54	39,98
Internt tilskud	4,02	3,63	4,02	3,89	4,02	3,89	4,02	4,02	3,89	4,02	3,89	4,02	47,30
Fra rør og VVB	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Samlet tilskud	4,84	5,14	6,79	8,37	10,17	10,23	10,15	9,03	7,28	5,89	4,81	4,56	87,28
Relativt tilskud	1,94	1,96	9,14	2,14	2,14	2,14	2,14	2,14	2,14	2,14	2,14	5,05	
Udnyttelses-faktor	0,52	0,51	0,11	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,20	0,44
Del af mnd. med opv.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Varmebehov	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Opvarm. i vent. VF	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	20,90
Netto rumopvarmning	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	20,90
I alt, kWh/m²	1,5	1,4	1,4	1,3	1,1	1,0	1,0	1,0	1,1	1,2	1,3	1,4	0,0
Solafskærmning, forceret vent., natvent. og køling													
	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Solafsk., red. faktor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	
Forcering, andel	0,00	0,00	0,00	0,00	0,40	0,70	0,78	0,69	0,25	0,00	0,00	0,00	
Natventilation, andel	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Mekanisk køling, andel	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Middelventilation. Sum af naturlig og mekanisk ventilation													
	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
m³/s	0,16	0,16	0,16	0,16	0,38	0,54	0,58	0,53	0,30	0,16	0,16	0,16	
l/s m²	0,11	0,11	0,11	0,11	0,26	0,37	0,40	0,37	0,21	0,11	0,11	0,11	
Andel af tid på eller over 26,0 °C rumtemperatur													
	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Tidsandel	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Mekanisk køling, netto													
	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
MWh	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Samlet varmetab, W/m²													
Varmetab	33,4												

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Ventilation uden vgv om vinteren	8,7
I alt	42,1
Ventilation med vgv om vinteren	2,6
I alt	36,0

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Calculation: Natural ventilation 20° Celsius:

Model: Hammershus speciale 2	SBi Beregningskerne 6, 11, 11, 24												
Be10 resultater: Hammershus													
Energibehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Varme	14,54	12,79	10,51	4,81	0,02	0,00	0,00	0,00	0,16	4,41	9,09	12,93	69,27
El til bygningsdrift	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,04
Overtemperatur i rum	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Samlet energibehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
BR 2010	14,55	12,80	10,52	4,82	0,03	0,01	0,01	0,01	0,17	4,42	9,10	12,94	69,38
kWh/m²	10,1	8,9	7,3	3,3	0,0	0,0	0,0	0,0	0,1	3,1	6,3	9,0	48,2
Lavenergibyggeri 2015	11,64	10,24	8,42	3,86	0,03	0,01	0,01	0,01	0,14	3,54	7,28	10,35	55,52
kWh/m²	8,1	7,1	5,8	2,7	0,0	0,0	0,0	0,0	0,1	2,5	5,1	7,2	38,6
Byggeri 2020	8,73	7,68	6,31	2,89	0,02	0,01	0,01	0,01	0,10	2,65	5,46	7,76	41,64
kWh/m²	6,1	5,3	4,4	2,0	0,0	0,0	0,0	0,0	0,1	1,8	3,8	5,4	28,9
Varmebehov. Ekstern forsyning til bygning													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Kedel/fjernvarme	14,54	12,79	10,51	4,81	0,02	0,00	0,00	0,00	0,16	4,41	9,09	12,93	69,27
Gasstrålevarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Gasvandvarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Køling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	14,54	12,79	10,51	4,81	0,02	0,00	0,00	0,00	0,16	4,41	9,09	12,93	69,27
kWh/m²	10,1	8,9	7,3	3,3	0,0	0,0	0,0	0,0	0,1	3,1	6,3	9,0	48,1
Elbehov. Ekstern forsyning til bygning. Bygningsdrift													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Centralvarmeanlæg	0	0	0	0	0	0	0	0	0	0	0	0	0
Varmt brugsvand	0	0	0	0	0	0	0	0	0	0	0	0	0
Ventilationsanlæg	0	0	0	0	0	0	0	0	0	0	0	0	0
Kedel/fjernvarme	4	3	4	4	4	4	4	4	4	4	4	4	44
Varmepumpe	0	0	0	0	0	0	0	0	0	0	0	0	0
Solvarme	0	0	0	0	0	0	0	0	0	0	0	0	0
Rumopvarmning	0	0	0	0	0	0	0	0	0	0	0	0	0
Dec. elvandvarmere	0	0	0	0	0	0	0	0	0	0	0	0	0
Køling	0	0	0	0	0	0	0	0	0	0	0	0	0
Belysning	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt til bygningsdrift	4	3	4	4	4	4	4	4	4	4	4	4	44

kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Elbehov. Ekstern forsyning til bygning. Andet elforbrug													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Anden belysning	112	101	112	108	112	108	112	112	108	112	108	112	1314
Apperatur	1875	1693	1875	1814	1875	1814	1875	1875	1814	1875	1814	1875	22075
I alt til andet	1986	1794	1986	1922	1986	1922	1986	1986	1922	1986	1922	1986	23389
kWh/m²	1,4	1,2	1,4	1,3	1,4	1,3	1,4	1,4	1,3	1,4	1,3	1,4	16,2
Elbehov. Ekstern forsyning til bygning. Samlet elbehov													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Bygningen	1990	1798	1990	1926	1990	1926	1990	1990	1926	1990	1926	1990	23433
Solcelleydelse	0	0	0	0	0	0	0	0	0	0	0	0	0
Vindmølleydelse	0	0	0	0	0	0	0	0	0	0	0	0	0
Resulterende elbehov	4	3	4	4	4	4	4	4	4	4	4	4	44
El til opvarmning	0	0	0	0	0	0	0	0	0	0	0	0	0
El til andet end opvarmning	4	3	4	4	4	4	4	4	4	4	4	4	44
Rumopvarmning, Varmebehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
I rum	14,54	12,79	10,51	4,81	0,02	0,00	0,00	0,00	0,16	4,41	9,09	12,93	69,27
Vent. varmefl.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Rørtab	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	14,54	12,79	10,51	4,81	0,02	0,00	0,00	0,00	0,16	4,41	9,09	12,93	69,27
I alt, kWh/m²	10,1	8,9	7,3	3,3	0,0	0,0	0,0	0,0	0,1	3,1	6,3	9,0	48,1
Rumopvarmning, Dækning af varmebehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Kedel/fjernvarme	14,54	12,79	10,51	4,81	0,02	0,00	0,00	0,00	0,16	4,41	9,09	12,93	69,27
Solvarmeanlæg	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Varmepumpe	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
El-rumopvarmning	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
El-VF i ventilationsanlæg	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Brændeovne mm.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	14,54	12,79	10,51	4,81	0,02	0,00	0,00	0,00	0,16	4,41	9,09	12,93	69,27
Varmt brugsvand, Varmtvandsbehov													
m³	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Samlet forbrug	12,2	11,0	12,2	11,8	12,2	11,8	12,2	12,2	11,8	12,2	11,8	12,2	144,0
Varmt brugsvand, Forsyning													
m³	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året

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Centralanlæg	12,2	11,0	12,2	11,8	12,2	11,8	12,2	12,2	11,8	12,2	11,8	12,2	144,0
Decentrale elvarmere	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Decentrale gasvarmere	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I alt	12,2	11,0	12,2	11,8	12,2	11,8	12,2	12,2	11,8	12,2	11,8	12,2	144,0
Varmt brugsvand, Varmebehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Central VVB	0,64	0,58	0,64	0,62	0,64	0,62	0,64	0,64	0,62	0,64	0,62	0,64	7,56
Dec. elvarmer	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Dec. gasvarmer	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Opvarmning i alt	0,64	0,58	0,64	0,62	0,64	0,62	0,64	0,64	0,62	0,64	0,62	0,64	7,56
Tab central VVB	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Tab tilslutningsrør til VVB	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
VBV rørtab	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Tab dec. elvandvarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Tab dec. gasvandvarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Tab i alt	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	0,64	0,58	0,64	0,62	0,64	0,62	0,64	0,64	0,62	0,64	0,62	0,64	7,56
kWh/m²	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	5,3
Varmt brugsvand, Dækning af varmebehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Kedel/fjernvarme	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Solvarmeanlæg	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Varmepumpe	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
El-opv. af central-VVB	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
El-tracing af VBV rør	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Dec. elvandvarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Dec. gasvandvarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Elbehov i varmeanlæg													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Direkte rumopv.	0	0	0	0	0	0	0	0	0	0	0	0	0
Pumper	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Elbehov i varmtbrugsvandsanlæg													

kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
El-opv. af central-VVB	0	0	0	0	0	0	0	0	0	0	0	0	0
El-tracing af VBV rør	0	0	0	0	0	0	0	0	0	0	0	0	0
Ladekredspumpe	0	0	0	0	0	0	0	0	0	0	0	0	0
Cirkulationspumpe vbv	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Elbehov i ventilationsanlæg													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Varmeflader	0	0	0	0	0	0	0	0	0	0	0	0	0
Ventilatorer	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Kedel/fjernvarmeveksler, Varme													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Ydelse	14,54	12,79	10,51	4,81	0,02	0,00	0,00	0,00	0,16	4,41	9,09	12,93	69,27
Forbrug	14,54	12,79	10,51	4,81	0,02	0,00	0,00	0,00	0,16	4,41	9,09	12,93	69,27
Udnytteligt varmetab	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Virkningsgrad	100	100	100	100	100	0	0	0	100	100	100	100	100
Kedel/fjernvarmeveksler, Elbehov													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Brænder, kWh	0	0	0	0	0	0	0	0	0	0	0	0	0
Automatik, kWh	4	3	4	4	4	4	4	4	4	4	4	4	44
I alt	4	3	4	4	4	4	4	4	4	4	4	4	44
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Varmepumpe, Varme													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Ydelse, Rumopv.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Ydelse, VBV	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Dækningsgr. Rumopv.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Dækningsgr. VBV	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Varmepumpe, Elbehov													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Elbehov, rumopv.	0	0	0	0	0	0	0	0	0	0	0	0	0
Elbehov, stb. rumopv.	0	0	0	0	0	0	0	0	0	0	0	0	0

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Elbehov, VBV	0	0	0	0	0	0	0	0	0	0	0	0	0
Elbehov, stb. VBV	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

Solvarmeanlæg, Varme													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Ydelse, Rumopv.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Ydelse, VBV	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Dækningsgr. Rumopv.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Dækningsgr. VBV	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	

Solvarmeanlæg, Elbehov													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Pumpe	0	0	0	0	0	0	0	0	0	0	0	0	0
Automatik	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

Elbehov til belysning. Indgår i bygningens ydeevne													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Almen i brugstiden	4520	4082	3106	2185	1693	1638	1693	1975	2732	4520	4374	4520	37038
Alm. st.-by udenf. brug	0	0	0	0	0	0	0	0	0	0	0	0	0
Arbejdsbelysning i brugstid	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	4520	4082	3106	2185	1693	1638	1693	1975	2732	4520	4374	4520	37038
kWh/m²	3,1	2,8	2,2	1,5	1,2	1,1	1,2	1,4	1,9	3,1	3,0	3,1	25,7

Elbehov til belysning. Anden belysning													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
I brugstiden	112	101	112	108	112	108	112	112	108	112	108	112	1314
Natforbrug	0	0	0	0	0	0	0	0	0	0	0	0	0
Parkeringskældre mv	0	0	0	0	0	0	0	0	0	0	0	0	0
Udelys	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	112	101	112	108	112	108	112	112	108	112	108	112	1314
kWh/m²	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,9

Elbehov til apperatur													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Apperatur	1875	1693	1875	1814	1875	1814	1875	1875	1814	1875	1814	1875	22075
Natforbrug, apparatur	0	0	0	0	0	0	0	0	0	0	0	0	0

Særligt app. i brugstiden	0	0	0	0	0	0	0	0	0	0	0	0	0
Særligt app. altid	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	1875	1693	1875	1814	1875	1814	1875	1875	1814	1875	1814	1875	22075
kWh/m²	1,3	1,2	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	15,3

Solceller og vindmøller													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Samlet el-behov	1879	1697	1879	1818	1879	1818	1879	1879	1818	1879	1818	1879	22119
Solceller	0	0	0	0	0	0	0	0	0	0	0	0	0
Vindmøller	0	0	0	0	0	0	0	0	0	0	0	0	0
Samlet ydelse	0	0	0	0	0	0	0	0	0	0	0	0	0
Balance	-1879	-1697	-1879	-1818	-1879	-1818	-1879	-1879	-1818	-1879	-1818	-1879	-22119
Overskud	0	0	0	0	0	0	0	0	0	0	0	0	0
Ydelsesjustering	0	0	0	0	0	0	0	0	0	0	0	0	0
Solceller, indregnet	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Vindmøller, indregnet	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

Nettovarmebehov i rum													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Varmetab	19,38	17,93	17,30	13,17	8,22	4,57	3,40	3,59	6,86	10,30	13,91	17,49	136,14
Solindfald	0,83	1,52	2,77	4,48	6,16	6,35	6,13	5,01	3,39	1,88	0,92	0,54	39,98
Internt tilskud	4,02	3,63	4,02	3,89	4,02	3,89	4,02	4,02	3,89	4,02	3,89	4,02	47,30
Fra rør og VVB	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Samlet tilskud	4,84	5,14	6,79	8,37	10,17	10,23	10,15	9,03	7,28	5,89	4,81	4,56	87,28
Relativt tilskud	0,25	0,29	0,39	0,64	1,24	2,24	2,98	2,51	1,06	0,57	0,35	0,26	
Udnyttelses-faktor	1,00	1,00	1,00	1,00	0,80	0,45	0,34	0,40	0,90	1,00	1,00	1,00	0,82
Del af mnd. med opv.	1,00	1,00	1,00	1,00	0,23	0,00	0,00	0,00	0,51	1,00	1,00	1,00	
Varmebehov	14,54	12,79	10,51	4,81	0,02	0,00	0,00	0,00	0,16	4,41	9,09	12,93	69,27
Opvarm. i vent. VF	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Netto rumopvarmning	14,54	12,79	10,51	4,81	0,02	0,00	0,00	0,00	0,16	4,41	9,09	12,93	69,27
I alt, kWh/m²	10,1	8,9	7,3	3,3	0,0	0,0	0,0	0,0	0,1	3,1	6,3	9,0	48,1

Solafskærmning, forceret vent., natvent. og køling													
	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Solafsk., red. faktor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	
Forcering, andel	0,00	0,00	0,00	0,00	0,33	0,66	0,76	0,67	0,20	0,00	0,00	0,00	

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Natventilation, andel	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Mekanisk køling, andel	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	

Middelventilation. Sum af naturlig og mekanisk ventilation													
	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
m³/s	0,16	0,16	0,16	0,16	0,88	1,59	1,81	1,60	0,60	0,16	0,16	0,16	
l/s m²	0,11	0,11	0,11	0,11	0,61	1,11	1,26	1,11	0,42	0,11	0,11	0,11	

Andel af tid på eller over 26,0 °C rumtemperatur													
	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Tidsandel	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Mekanisk køling, netto													
	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
MWh	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

Samlet varmetab, W/m²	
Varmetab	33,4
Ventilation uden vgv om vinteren	8,7
I alt	42,1
Ventilation med vgv om vinteren	8,7
I alt	42,1

Calculation: Mechanical ventilation 5° Celsius:

Model: Hammershus speciale 2	SBi Beregningskerne 6, 11, 11, 24												
Be10 resultater: Hammershus													
Energibehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Å
Varme	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	2
El til bygningsdrift	0,26	0,23	0,26	0,25	1,62	2,55	2,90	2,60	1,08	0,26	0,25	0,26	1
Overtemperatur i rum	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0
Samlet energibehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Å
BR 2010	2,78	2,53	2,68	2,43	5,67	7,78	8,65	7,91	4,21	2,36	2,46	2,69	5
kWh/m²	1,9	1,8	1,9	1,7	3,9	5,4	6,0	5,5	2,9	1,6	1,7	1,9	3
Lavenergibyggeri 2015	2,35	2,14	2,27	2,07	5,34	7,50	8,37	7,63	3,90	2,02	2,10	2,28	4
kWh/m²	1,6	1,5	1,6	1,4	3,7	5,2	5,8	5,3	2,7	1,4	1,5	1,6	3
Byggeri 2020	1,74	1,59	1,69	1,53	3,89	5,44	6,06	5,53	2,85	1,49	1,55	1,69	3
kWh/m²	1,2	1,1	1,2	1,1	2,7	3,8	4,2	3,8	2,0	1,0	1,1	1,2	2
Varmebehov. Ekstern forsyning til bygning													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Å
Kedel/fjernvarme	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	2
Gasstrålevarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0
Gasvandvarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0
Køling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0
I alt	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	2
kWh/m²	1,5	1,4	1,4	1,3	1,1	1,0	1,0	1,0	1,1	1,2	1,3	1,4	1
Elbehov. Ekstern forsyning til bygning. Bygningsdrift													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Å
Centralvarmeanlæg	0	0	0	0	0	0	0	0	0	0	0	0	0
Varmt brugsvand	0	0	0	0	0	0	0	0	0	0	0	0	0
Ventilationsanlæg	253	229	253	245	1615	2546	2899	2598	1073	253	245	253	1
Kedel/fjernvarme	4	3	4	4	4	4	4	4	4	4	4	4	4
Varmepumpe	0	0	0	0	0	0	0	0	0	0	0	0	0
Solvarme	0	0	0	0	0	0	0	0	0	0	0	0	0
Rumopvarmning	0	0	0	0	0	0	0	0	0	0	0	0	0
Dec. elvandvarmere	0	0	0	0	0	0	0	0	0	0	0	0	0
Køling	0	0	0	0	0	0	0	0	0	0	0	0	0
Belysning	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt til bygningsdrift	257	232	257	249	1619	2549	2902	2602	1076	257	249	257	1
kWh/m²	0,2	0,2	0,2	0,2	1,1	1,8	2,0	1,8	0,7	0,2	0,2	0,2	8

kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Anden belysning	112	101	112	108	112	108	112	112	108	112	108	112	1314
Apperatur	1875	1693	1875	1814	1875	1814	1875	1875	1814	1875	1814	1875	22075
I alt til andet	1986	1794	1986	1922	1986	1922	1986	1986	1922	1986	1922	1986	23389
kWh/m²	1,4	1,2	1,4	1,3	1,4	1,3	1,4	1,4	1,3	1,4	1,3	1,4	16,2
Elbehov. Ekstern forsyning til bygning. Samlet elbehov													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Bygningen	2243	2026	2243	2171	3605	4472	4889	4588	2999	2243	2171	2243	35894
Solcelleydelse	0	0	0	0	0	0	0	0	0	0	0	0	0
Vindmølleydelse	0	0	0	0	0	0	0	0	0	0	0	0	0
Resulterende elbehov	257	232	257	249	1619	2549	2902	2602	1076	257	249	257	12505
El til opvarmning	0	0	0	0	0	0	0	0	0	0	0	0	0
El til andet end opvarmning	257	232	257	249	1619	2549	2902	2602	1076	257	249	257	12505
Rumopvarmning, Varmebehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
I rum	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Vent. varmefl.	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	20,90
Rørtab	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	20,90
I alt, kWh/m²	1,5	1,4	1,4	1,3	1,1	1,0	1,0	1,0	1,1	1,2	1,3	1,4	14,5
Rumopvarmning, Dækning af varmebehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Kedel/fjernvarme	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	20,90
Solvarmeanlæg	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Varmepumpe	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
El-rumopvarmning	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
El-VF i ventilationsanlæg	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Brændeovne mm.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	20,90
Varmt brugsvand, Varmtvandsbehov													
m³	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Samlet forbrug	12,2	11,0	12,2	11,8	12,2	11,8	12,2	12,2	11,8	12,2	11,8	12,2	144,0
Varmt brugsvand, Forsyning													
m³	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Centralanlæg	12,2	11,0	12,2	11,8	12,2	11,8	12,2	12,2	11,8	12,2	11,8	12,2	144,0
Decentrale elvarmere	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Decentrale gasvarmere	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I alt	12,2	11,0	12,2	11,8	12,2	11,8	12,2	12,2	11,8	12,2	11,8	12,2	144,0

Varmt brugsvand, Varmebehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Central VVB	0,64	0,58	0,64	0,62	0,64	0,62	0,64	0,64	0,62	0,64	0,62	0,64	7,56
Dec. elvarmer	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Dec. gasvarmer	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Opvarmning i alt	0,64	0,58	0,64	0,62	0,64	0,62	0,64	0,64	0,62	0,64	0,62	0,64	7,56
Tab central VVB	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Tab tilslutningsrør til VVB	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
VBV rørtab	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Tab dec. elvandvarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Tab dec. gasvandvarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Tab i alt	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	0,64	0,58	0,64	0,62	0,64	0,62	0,64	0,64	0,62	0,64	0,62	0,64	7,56
kWh/m²	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	5,3
Varmt brugsvand, Dækning af varmebehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Kedel/fjernvarme	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Solvarmeanlæg	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Varmepumpe	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
El-opv. af central-VVB	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
El-tracing af VBV rør	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Dec. elvandvarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Dec. gasvandvarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Elbehov i varmeanlæg													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Direkte rumopv.	0	0	0	0	0	0	0	0	0	0	0	0	0
Pumper	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Elbehov i varmtbrugsvandsanlæg													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
El-opv. af central-VVB	0	0	0	0	0	0	0	0	0	0	0	0	0
El-tracing af VBV rør	0	0	0	0	0	0	0	0	0	0	0	0	0
Ladekredspumpe	0	0	0	0	0	0	0	0	0	0	0	0	0
Cirkulationspumpe vbv	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Elbehov i ventilationsanlæg													

kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Varmeflader	0	0	0	0	0	0	0	0	0	0	0	0	0
Ventilatorer	253	229	253	245	1615	2546	2899	2598	1073	253	245	253	12461
I alt	253	229	253	245	1615	2546	2899	2598	1073	253	245	253	12461
kWh/m²	0,2	0,2	0,2	0,2	1,1	1,8	2,0	1,8	0,7	0,2	0,2	0,2	8,7
Kedel/fjernvarmeveksler, Varme													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Ydelse	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	20,90
Forbrug	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	20,90
Udnytteligt varmetab	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Virkningsgrad	100	100	100	100	100	100	100	100	100	100	100	100	100
Kedel/fjernvarmeveksler, Elbehov													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Brænder, kWh	0	0	0	0	0	0	0	0	0	0	0	0	0
Automatik, kWh	4	3	4	4	4	4	4	4	4	4	4	4	44
I alt	4	3	4	4	4	4	4	4	4	4	4	4	44
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Varmepumpe, Varme													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Ydelse, Rumopv.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Ydelse, VBV	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Dækningsgr. Rumopv.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Dækningsgr. VBV	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Varmepumpe, Elbehov													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Elbehov, rumopv.	0	0	0	0	0	0	0	0	0	0	0	0	0
Elbehov, stb. rumopv.	0	0	0	0	0	0	0	0	0	0	0	0	0
Elbehov, VBV	0	0	0	0	0	0	0	0	0	0	0	0	0
Elbehov, stb. VBV	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Solvarmeanlæg, Varme													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Ydelse, Rumopv.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Ydelse, VBV	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Dækningsgr. Rumopv.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Dækningsgr. VBV	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	

Solvarmeanlæg, Elbehov													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Pumpe	0	0	0	0	0	0	0	0	0	0	0	0	0
Automatik	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Elbehov til belysning. Indgår i bygningens ydeevne													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Almen i brugstiden	4520	4082	3106	2185	1693	1638	1693	1975	2732	4520	4374	4520	37038
Alm. st.-by udenf. brug	0	0	0	0	0	0	0	0	0	0	0	0	0
Arbejdsbelysning i brugstid	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	4520	4082	3106	2185	1693	1638	1693	1975	2732	4520	4374	4520	37038
kWh/m²	3,1	2,8	2,2	1,5	1,2	1,1	1,2	1,4	1,9	3,1	3,0	3,1	25,7
Elbehov til belysning. Anden belysning													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
I brugstiden	112	101	112	108	112	108	112	112	108	112	108	112	1314
Natforbrug	0	0	0	0	0	0	0	0	0	0	0	0	0
Parkeringskældre mv	0	0	0	0	0	0	0	0	0	0	0	0	0
Udelys	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	112	101	112	108	112	108	112	112	108	112	108	112	1314
kWh/m²	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,9
Elbehov til apperatur													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Apperatur	1875	1693	1875	1814	1875	1814	1875	1875	1814	1875	1814	1875	22075
Natforbrug, apparatur	0	0	0	0	0	0	0	0	0	0	0	0	0
Særligt app. i brugstiden	0	0	0	0	0	0	0	0	0	0	0	0	0
Særligt app. altid	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	1875	1693	1875	1814	1875	1814	1875	1875	1814	1875	1814	1875	22075
kWh/m²	1,3	1,2	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	15,3
Solceller og vindmøller													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Samlet el-behov	2132	1925	2132	2063	3494	4364	4777	4477	2891	2132	2063	2132	34580
Solceller	0	0	0	0	0	0	0	0	0	0	0	0	0
Vindmøller	0	0	0	0	0	0	0	0	0	0	0	0	0
Samlet ydelse	0	0	0	0	0	0	0	0	0	0	0	0	0
Balance	-2132	-1925	-2132	-2063	-3494	-4364	-4777	-4477	-2891	-2132	-2063	-2132	-34580
Overskud	0	0	0	0	0	0	0	0	0	0	0	0	0

Ydelsesjustering	0	0	0	0	0	0	0	0	0	0	0	0	0
Solceller, indregnet	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Vindmøller, indregnet	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Nettovarmebehov i rum													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Varmetab	2,50	2,62	0,74	-2,30	-6,93	-9,57	-11,01	-10,85	-7,64	-5,17	-1,68	0,90	-48,39
Solindfald	0,83	1,52	2,77	4,48	6,16	6,35	6,13	5,01	3,39	1,88	0,92	0,54	39,98
Internt tilskud	4,02	3,63	4,02	3,89	4,02	3,89	4,02	4,02	3,89	4,02	3,89	4,02	47,30
Fra rør og VVB	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Samlet tilskud	4,84	5,14	6,79	8,37	10,17	10,23	10,15	9,03	7,28	5,89	4,81	4,56	87,28
Relativt tilskud	1,94	1,96	9,14	2,14	2,14	2,14	2,14	2,14	2,14	2,14	2,14	5,05	
Udnyttelses-faktor	0,52	0,51	0,11	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,50	0,20	0,44
Del af mnd. med opv.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Varmebehov	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Opvarm. i vent. VF	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	20,90
Netto rumopvarmning	2,14	1,95	2,04	1,81	1,62	1,41	1,40	1,41	1,52	1,72	1,84	2,05	20,90
I alt, kWh/m²	1,5	1,4	1,4	1,3	1,1	1,0	1,0	1,0	1,1	1,2	1,3	1,4	0,0
Solafskærmning, forceret vent., natvent. og køling													
	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Solafsk., red. faktor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	
Forcering, andel	0,00	0,00	0,00	0,00	0,40	0,70	0,78	0,69	0,25	0,00	0,00	0,00	
Natventilation, andel	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Mekanisk køling, andel	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Middelventilation. Sum af naturlig og mekanisk ventilation													
	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
m³/s	0,16	0,16	0,16	0,16	0,38	0,54	0,58	0,53	0,30	0,16	0,16	0,16	
l/s m²	0,11	0,11	0,11	0,11	0,26	0,37	0,40	0,37	0,21	0,11	0,11	0,11	
Andel af tid på eller over 26,0 °C rumtemperatur													
	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Tidsandel	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Mekanisk køling, netto													
	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
MWh	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Samlet varmetab, W/m²													
Varmetab	33,4												

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Ventilation uden vgv om vinteren	8,7
I alt	42,1
Ventilation med vgv om vinteren	2,6
I alt	36,0

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Calculation: Mechanical ventilation 20° Celsius:

Model: Hammershus speciale 2	SBi Beregningskerne 6, 11, 11, 24												
Be10 resultater: Hammershus													
Energibehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Varme	12,44	10,85	8,64	3,41	0,09	0,00	0,00	0,00	0,06	3,30	7,59	11,04	57,42
El til bygningsdrift	0,26	0,23	0,26	0,25	1,62	2,55	2,90	2,60	1,08	0,26	0,25	0,26	12,50
Overtemperatur i rum	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Samlet energibehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
BR 2010	13,09	11,43	9,28	4,03	4,14	6,37	7,26	6,50	2,75	3,95	8,21	11,68	88,68
kWh/m²	9,1	7,9	6,4	2,8	2,9	4,4	5,0	4,5	1,9	2,7	5,7	8,1	61,6
Lavenergibyggeri 2015	10,60	9,26	7,56	3,35	4,12	6,37	7,26	6,50	2,74	3,28	6,69	9,47	77,20
kWh/m²	7,4	6,4	5,2	2,3	2,9	4,4	5,0	4,5	1,9	2,3	4,6	6,6	53,6
Byggeri 2020	7,93	6,93	5,65	2,49	2,97	4,59	5,22	4,68	1,97	2,44	5,00	7,09	56,96
kWh/m²	5,5	4,8	3,9	1,7	2,1	3,2	3,6	3,3	1,4	1,7	3,5	4,9	39,6
Varmebehov. Ekstern forsyning til bygning													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Kedel/fjernvarme	12,44	10,85	8,64	3,41	0,09	0,00	0,00	0,00	0,06	3,30	7,59	11,04	57,42
Gasstrålevarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Gasvandvarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Køling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	12,44	10,85	8,64	3,41	0,09	0,00	0,00	0,00	0,06	3,30	7,59	11,04	57,42
kWh/m²	8,6	7,5	6,0	2,4	0,1	0,0	0,0	0,0	0,0	2,3	5,3	7,7	39,9
Elbehov. Ekstern forsyning til bygning. Bygningsdrift													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Centralvarmeanlæg	0	0	0	0	0	0	0	0	0	0	0	0	0
Varmt brugsvand	0	0	0	0	0	0	0	0	0	0	0	0	0
Ventilationsanlæg	253	229	253	245	1615	2546	2899	2598	1073	253	245	253	12461
Kedel/fjernvarme	4	3	4	4	4	4	4	4	4	4	4	4	44
Varmepumpe	0	0	0	0	0	0	0	0	0	0	0	0	0
Solvarme	0	0	0	0	0	0	0	0	0	0	0	0	0
Rumopvarmning	0	0	0	0	0	0	0	0	0	0	0	0	0
Dec. elvandvarmere	0	0	0	0	0	0	0	0	0	0	0	0	0
Køling	0	0	0	0	0	0	0	0	0	0	0	0	0
Belysning	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt til bygningsdrift	257	232	257	249	1619	2549	2902	2602	1076	257	249	257	12505

kWh/m²	0,2	0,2	0,2	0,2	1,1	1,8	2,0	1,8	0,7	0,2	0,2	0,2	8,7
Elbehov. Ekstern forsyning til bygning. Andet elforbrug													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Anden belysning	112	101	112	108	112	108	112	112	108	112	108	112	1314
Apperatur	1875	1693	1875	1814	1875	1814	1875	1875	1814	1875	1814	1875	22075
I alt til andet	1986	1794	1986	1922	1986	1922	1986	1986	1922	1986	1922	1986	23389
kWh/m²	1,4	1,2	1,4	1,3	1,4	1,3	1,4	1,4	1,3	1,4	1,3	1,4	16,2
Elbehov. Ekstern forsyning til bygning. Samlet elbehov													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Bygningen	2243	2026	2243	2171	3605	4472	4889	4588	2999	2243	2171	2243	35894
Solcelleydelse	0	0	0	0	0	0	0	0	0	0	0	0	0
Vindmølleydelse	0	0	0	0	0	0	0	0	0	0	0	0	0
Resulterende elbehov	257	232	257	249	1619	2549	2902	2602	1076	257	249	257	12505
El til opvarmning	0	0	0	0	0	0	0	0	0	0	0	0	0
El til andet end opvarmning	257	232	257	249	1619	2549	2902	2602	1076	257	249	257	12505
Rumopvarmning, Varmebehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
I rum	11,84	10,28	8,13	3,08	0,00	0,00	0,00	0,00	0,02	3,12	7,23	10,52	54,23
Vent. varmefl.	0,61	0,57	0,51	0,33	0,09	0,00	0,00	0,00	0,04	0,19	0,36	0,52	3,20
Rørtab	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	12,44	10,85	8,64	3,41	0,09	0,00	0,00	0,00	0,06	3,30	7,59	11,04	57,42
I alt, kWh/m²	8,6	7,5	6,0	2,4	0,1	0,0	0,0	0,0	0,0	2,3	5,3	7,7	39,9
Rumopvarmning, Dækning af varmebehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Kedel/fjernvarme	12,44	10,85	8,64	3,41	0,09	0,00	0,00	0,00	0,06	3,30	7,59	11,04	57,42
Solvarmeanlæg	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Varmepumpe	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
El-rumopvarmning	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
El-VF i ventilationsanlæg	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Brændeovne mm.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	12,44	10,85	8,64	3,41	0,09	0,00	0,00	0,00	0,06	3,30	7,59	11,04	57,42
Varmt brugsvand, Varmtvandsbehov													
m³	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Samlet forbrug	12,2	11,0	12,2	11,8	12,2	11,8	12,2	12,2	11,8	12,2	11,8	12,2	144,0
Varmt brugsvand, Forsyning													
m³	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Centralanlæg	12,2	11,0	12,2	11,8	12,2	11,8	12,2	12,2	11,8	12,2	11,8	12,2	144,0

Decentrale elvarmere	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Decentrale gasvarmere	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
I alt	12,2	11,0	12,2	11,8	12,2	11,8	12,2	12,2	11,8	12,2	11,8	12,2	144,0
Varmt brugsvand, Varmebehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Central VVB	0,64	0,58	0,64	0,62	0,64	0,62	0,64	0,64	0,62	0,64	0,62	0,64	7,56
Dec. elvarmer	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Dec. gasvarmer	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Opvarmning i alt	0,64	0,58	0,64	0,62	0,64	0,62	0,64	0,64	0,62	0,64	0,62	0,64	7,56
Tab central VVB	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Tab tilslutningsrør til VVB	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
VBV rørtab	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Tab dec. elvandvarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Tab dec. gasvandvarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Tab i alt	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	0,64	0,58	0,64	0,62	0,64	0,62	0,64	0,64	0,62	0,64	0,62	0,64	7,56
kWh/m²	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	5,3
Varmt brugsvand, Dækning af varmebehov													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Kedel/fjernvarme	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Solvarmeanlæg	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Varmepumpe	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
El-opv. af central-VVB	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
El-tracing af VBV rør	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Dec. elvandvarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Dec. gasvandvarmere	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Elbehov i varmeanlæg													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Direkte rumopv.	0	0	0	0	0	0	0	0	0	0	0	0	0
Pumper	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Elbehov i varmtbrugsvandsanlæg													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
El-opv. af central-VVB	0	0	0	0	0	0	0	0	0	0	0	0	0

El-tracing af VBV rør	0	0	0	0	0	0	0	0	0	0	0	0	0
Ladekredspumpe	0	0	0	0	0	0	0	0	0	0	0	0	0
Cirkulationspumpe vbv	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Elbehov i ventilationsanlæg													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Varmeflader	0	0	0	0	0	0	0	0	0	0	0	0	0
Ventilatorer	253	229	253	245	1615	2546	2899	2598	1073	253	245	253	12461
I alt	253	229	253	245	1615	2546	2899	2598	1073	253	245	253	12461
kWh/m²	0,2	0,2	0,2	0,2	1,1	1,8	2,0	1,8	0,7	0,2	0,2	0,2	8,7
Kedel/fjernvarmeveksler, Varme													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Ydelse	12,44	10,85	8,64	3,41	0,09	0,00	0,00	0,00	0,06	3,30	7,59	11,04	57,42
Forbrug	12,44	10,85	8,64	3,41	0,09	0,00	0,00	0,00	0,06	3,30	7,59	11,04	57,42
Udnytteligt varmetab	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Virkningsgrad	100	100	100	100	100	0	0	0	100	100	100	100	100
Kedel/fjernvarmeveksler, Elbehov													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Brænder, kWh	0	0	0	0	0	0	0	0	0	0	0	0	0
Automatik, kWh	4	3	4	4	4	4	4	4	4	4	4	4	44
I alt	4	3	4	4	4	4	4	4	4	4	4	4	44
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Varmepumpe, Varme													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Ydelse, Rumopv.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Ydelse, VBV	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Dækningsgr. Rumopv.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Dækningsgr. VBV	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Varmepumpe, Elbehov													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Elbehov, rumopv.	0	0	0	0	0	0	0	0	0	0	0	0	0
Elbehov, stb. rumopv.	0	0	0	0	0	0	0	0	0	0	0	0	0
Elbehov, VBV	0	0	0	0	0	0	0	0	0	0	0	0	0
Elbehov, stb. VBV	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	0	0	0	0	0	0	0	0	0	0	0	0	0

kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Solvarmeanlæg, Varme													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Ydelse, Rumopv.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Ydelse, VBV	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
I alt	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Dækningsgr. Rumopv.	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Dækningsgr. VBV	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Solvarmeanlæg, Elbehov													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Pumpe	0	0	0	0	0	0	0	0	0	0	0	0	0
Automatik	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Elbehov til belysning. Indgår i bygningens ydeevne													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Almen i brugstiden	4520	4082	3106	2185	1693	1638	1693	1975	2732	4520	4374	4520	37038
Alm. st.-by udenf. brug	0	0	0	0	0	0	0	0	0	0	0	0	0
Arbejdsbelysning i brugstid	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	4520	4082	3106	2185	1693	1638	1693	1975	2732	4520	4374	4520	37038
kWh/m²	3,1	2,8	2,2	1,5	1,2	1,1	1,2	1,4	1,9	3,1	3,0	3,1	25,7
Elbehov til belysning. Anden belysning													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
I brugstiden	112	101	112	108	112	108	112	112	108	112	108	112	1314
Natforbrug	0	0	0	0	0	0	0	0	0	0	0	0	0
Parkeringskældre mv	0	0	0	0	0	0	0	0	0	0	0	0	0
Udelys	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	112	101	112	108	112	108	112	112	108	112	108	112	1314
kWh/m²	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,9
Elbehov til apperatur													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Apperatur	1875	1693	1875	1814	1875	1814	1875	1875	1814	1875	1814	1875	22075
Natforbrug, apparatur	0	0	0	0	0	0	0	0	0	0	0	0	0
Særligt app. i brugstiden	0	0	0	0	0	0	0	0	0	0	0	0	0
Særligt app. altid	0	0	0	0	0	0	0	0	0	0	0	0	0
I alt	1875	1693	1875	1814	1875	1814	1875	1875	1814	1875	1814	1875	22075

kWh/m²	1,3	1,2	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3	15,3
Solceller og vindmøller													
kWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Samlet el-behov	2132	1925	2132	2063	3494	4364	4777	4477	2891	2132	2063	2132	34580
Solceller	0	0	0	0	0	0	0	0	0	0	0	0	0
Vindmøller	0	0	0	0	0	0	0	0	0	0	0	0	0
Samlet ydelse	0	0	0	0	0	0	0	0	0	0	0	0	0
Balance	-2132	-1925	-2132	-2063	-3494	-4364	-4777	-4477	-2891	-2132	-2063	-2132	-34580
Overskud	0	0	0	0	0	0	0	0	0	0	0	0	0
Ydelsesjustering	0	0	0	0	0	0	0	0	0	0	0	0	0
Solceller, indregnet	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Vindmøller, indregnet	0	0	0	0	0	0	0	0	0	0	0	0	0
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Nettovarmebehov i rum													
MWh	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Varmetab	16,68	15,43	14,92	11,42	7,25	4,15	3,17	3,33	6,09	9,01	12,04	15,08	118,57
Solindfald	0,83	1,52	2,77	4,48	6,16	6,35	6,13	5,01	3,39	1,88	0,92	0,54	39,98
Internt tilskud	4,02	3,63	4,02	3,89	4,02	3,89	4,02	4,02	3,89	4,02	3,89	4,02	47,30
Fra rør og VVB	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Samlet tilskud	4,84	5,14	6,79	8,37	10,17	10,23	10,15	9,03	7,28	5,89	4,81	4,56	87,28
Relativt tilskud	0,29	0,33	0,46	0,73	1,40	2,47	3,20	2,71	1,20	0,65	0,40	0,30	
Udnyttelses-faktor	1,00	1,00	1,00	1,00	0,71	0,41	0,31	0,37	0,83	1,00	1,00	1,00	0,80
Del af mnd. med opv.	1,00	1,00	1,00	1,00	0,00	0,00	0,00	0,00	0,26	1,00	1,00	1,00	
Varmebehov	11,84	10,28	8,13	3,08	0,00	0,00	0,00	0,00	0,02	3,12	7,23	10,52	54,23
Opvarm. i vent. VF	0,61	0,57	0,51	0,33	0,09	0,00	0,00	0,00	0,04	0,19	0,36	0,52	3,20
Netto rumopvarmning	12,44	10,85	8,64	3,41	0,09	0,00	0,00	0,00	0,06	3,30	7,59	11,04	57,42
I alt, kWh/m²	8,6	7,5	6,0	2,4	0,1	0,0	0,0	0,0	0,0	2,3	5,3	7,7	37,7
Solafskærmning, forceret vent., natvent. og køling													
	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Solafsk., red. faktor	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	
Forcering, andel	0,00	0,00	0,00	0,00	0,40	0,70	0,78	0,69	0,25	0,00	0,00	0,00	
Natventilation, andel	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Mekanisk køling, andel	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	
Middelventilation. Sum af naturlig og mekanisk ventilation													
	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
m³/s	0,16	0,16	0,16	0,16	0,38	0,54	0,58	0,53	0,30	0,16	0,16	0,16	

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l/s m²	0,11	0,11	0,11	0,11	0,26	0,37	0,40	0,37	0,21	0,11	0,11	0,11
Andel af tid på eller over 26,0 °C rumtemperatur												
	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
Tidsandel	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Mekanisk køling, netto													
	Jan	Feb	Mar	Apr	Maj	Jun	Jul	Aug	Sep	Okt	Nov	Dec	Året
MWh	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
kWh/m²	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0

Samlet varmetab, W/m²	
Varmetab	33,4
Ventilation uden vgv om vinteren	8,7
I alt	42,1
Ventilation med vgv om vinteren	2,6
I alt	36,0

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APPENDIX B

Calculation: Hammershus with original walls:

Year 2012, tstep=50, RadModel=Petersen, Options: optimized xsun moist longwsky longwave latheat

Month	Sum/Mean	1	2	3	4	5	6	7
qHeating	5659,76	0,00	0,00	0,00	1622,10	992,39	453,47	245,96
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-10323,66	-107,11	-250,24	-521,52	-1353,78	-1450,58	-1257,20	-1214,89
qVenting	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qSunRad	9807,01	179,99	350,66	679,79	1103,98	1552,19	1589,54	1543,32
qPeople	18489,60	0,00	0,00	0,00	2592,00	2678,40	2592,00	2678,40
qEquipment	171,20	0,00	0,00	0,00	24,00	24,80	24,00	24,80
qLighting	3014,37	0,00	0,00	0,00	425,60	426,70	407,00	423,47
qTransmission	-5785,93	-72,88	-100,42	-158,27	-1234,20	-653,43	-741,53	-739,90
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	-21032,34	0,00	0,00	0,00	-3179,70	-3570,47	-3067,27	-2961,16
Sum	-0,00	-0,00	-0,00	-0,00	-0,00	0,00	-0,00	0,00
tOutdoor mean(℃)	7,7	-0,5	-0,8	1,7	5,6	11,3	15,0	16,4
tOp mean(℃)	11,3	-0,1	0,2	3,7	11,3	17,4	20,4	21,5
AirChange(/h)	2,2	0,7	0,7	0,7	3,2	3,2	3,2	3,2
Rel. Moisture(%)	67,6	81,3	80,7	73,4	60,4	53,1	58,0	60,5
Co2(ppm)	443,5	350,0	350,0	350,0	514,2	510,4	508,7	508,0
PAQ(-)	0,7	1,0	1,0	1,0	0,9	0,6	0,3	0,2
Hours > 21	1155	0	0	0	0	55	266	407
Hours > 26	75	0	0	0	0	0	28	31
Hours > 27	25	0	0	0	0	0	11	10
Hours < 20	7190	744	696	744	719	649	363	220
FanPow	9244,80	0,00	0,00	0,00	1296,00	1339,20	1296,00	1339,20
HtRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
ClRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HtCoil	9213,00	0,00	0,00	0,00	1438,60	1391,26	1196,96	1136,80
ClCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Humidif	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorHeat	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorCool	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPumpPow	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCoolingPow	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPump	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Year 2012, tstep=50, RadModel=Petersen, Options: optimized xsun moist longwsky longw

Month	8	9	10	11	12
qHeating	244,85	828,41	1272,58	0,00	0,00
qCooling	0,00	0,00	0,00	0,00	0,00
qInfiltration	-1208,61	-1208,81	-1225,73	-408,36	-116,84
qVenting	0,00	0,00	0,00	0,00	0,00
qSunRad	1252,10	809,97	412,92	210,60	121,96
qPeople	2678,40	2592,00	2678,40	0,00	0,00
qEquipment	24,80	24,00	24,80	0,00	0,00
qLighting	433,99	433,60	464,00	0,00	0,00
qTransmission	-516,71	-788,72	-972,51	197,76	-5,12
qMixing	0,00	0,00	0,00	0,00	0,00
qVentilation	-2908,83	-2690,45	-2654,46	0,00	0,00
Sum	0,00	0,00	0,00	-0,00	0,00
tOutdoor mean(℃)	16,2	12,5	9,1	4,8	1,5
tOp mean(℃)	21,3	17,7	14,1	6,5	1,9
AirChange(/h)	3,2	3,2	3,2	0,7	0,7
Rel. Moisture(%)	58,0	65,9	62,7	78,1	79,3
Co2(ppm)	508,2	510,3	512,5	350,0	350,0
PAQ(-)	0,2	0,4	0,7	1,0	1,0
Hours > 21	403	24	0	0	0
Hours > 26	16	0	0	0	0
Hours > 27	4	0	0	0	0
Hours < 20	203	644	744	720	744
FanPow	1339,20	1296,00	1339,20	0,00	0,00
HtRec	0,00	0,00	0,00	0,00	0,00
ClRec	0,00	0,00	0,00	0,00	0,00
HtCoil	1166,85	1397,82	1484,72	0,00	0,00
ClCoil	0,00	0,00	0,00	0,00	0,00
Humidif	0,00	0,00	0,00	0,00	0,00
FloorHeat	0,00	0,00	0,00	0,00	0,00
FloorCool	0,00	0,00	0,00	0,00	0,00
CentHeatPumpPow	0,00	0,00	0,00	0,00	0,00
CentCoolingPow	0,00	0,00	0,00	0,00	0,00
CentHeatPump	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00

Calculation: Hammershus with insulated walls:

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Year 2012, tstep=50, RadModel=Petersen, Options: optimized xsun moist longwsky longwave latheat

Month	Sum/Mean	1	2	3	4	5	6	7
qHeating	5521,35	0,00	0,00	0,00	1620,32	970,64	424,39	217,33
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-11178,70	-131,17	-271,04	-582,75	-1466,70	-1542,01	-1327,58	-1283,27
qVenting	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qSunRad	9807,01	179,99	350,66	679,79	1103,98	1552,19	1589,54	1543,32
qPeople	18489,60	0,00	0,00	0,00	2592,00	2678,40	2592,00	2678,40
qEquipment	171,20	0,00	0,00	0,00	24,00	24,80	24,00	24,80
qLighting	3014,07	0,00	0,00	0,00	425,60	426,70	407,00	423,40
qTransmission	-2629,23	-48,82	-79,62	-97,04	-729,74	-230,38	-405,94	-413,34
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	-23195,30	0,00	0,00	0,00	-3569,45	-3880,33	-3303,41	-3190,63
Sum	-0,00	0,00	-0,00	0,00	-0,00	0,00	-0,00	-0,00
tOutdoor mean(℃)	7,7	-0,5	-0,8	1,7	5,6	11,3	15,0	16,4
tOp mean(℃)	11,6	-0,0	0,3	4,0	11,7	17,7	20,7	21,8
AirChange(/h)	2,2	0,7	0,7	0,7	3,2	3,2	3,2	3,2
Rel. Moisture(%)	66,5	80,6	80,2	72,6	58,8	51,9	57,0	59,6
Co2(ppm)	443,3	350,0	350,0	350,0	513,8	510,1	508,4	507,7
PAQ(-)	0,7	1,0	1,0	1,0	0,9	0,5	0,3	0,1
Hours > 21	1292	0	0	0	0	71	303	438
Hours > 26	98	0	0	0	0	0	38	39
Hours > 27	42	0	0	0	0	0	14	18
Hours < 20	7033	744	696	744	716	618	334	192
FanPow	9244,80	0,00	0,00	0,00	1296,00	1339,20	1296,00	1339,20
HtRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
ClRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HtCoil	9213,00	0,00	0,00	0,00	1438,60	1391,26	1196,96	1136,80
ClCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Humidif	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorHeat	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorCool	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPumpPow	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCoolingPow	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPump	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

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Year 2012, tstep=50, RadModel=Petersen, Options: optimized xsun moist longwsky longwave latt

Month	8	9	10	11	12
qHeating	213,54	802,56	1272,58	0,00	0,00
qCooling	0,00	0,00	0,00	0,00	0,00
qInfiltration	-1282,24	-1300,19	-1350,66	-489,60	-151,49
qVenting	0,00	0,00	0,00	0,00	0,00
qSunRad	1252,10	809,97	412,92	210,60	121,96
qPeople	2678,40	2592,00	2678,40	0,00	0,00
qEquipment	24,80	24,00	24,80	0,00	0,00
qLighting	433,77	433,60	464,00	0,00	0,00
qTransmission	-162,90	-357,90	-412,06	279,01	29,53
qMixing	0,00	0,00	0,00	0,00	0,00
qVentilation	-3157,47	-3004,03	-3089,97	0,00	0,00
Sum	-0,00	0,00	0,00	-0,00	-0,00
tOutdoor mean(℃)	16,2	12,5	9,1	4,8	1,5
tOp mean(℃)	21,6	18,1	14,6	6,8	2,0
AirChange(/h)	3,2	3,2	3,2	0,7	0,7
Rel. Moisture(%)	57,0	64,4	60,8	76,3	78,4
Co2(ppm)	507,9	509,9	512,0	350,0	350,0
PAQ(-)	0,2	0,4	0,7	0,9	1,0
Hours > 21	438	42	0	0	0
Hours > 26	21	0	0	0	0
Hours > 27	10	0	0	0	0
Hours < 20	169	612	744	720	744
FanPow	1339,20	1296,00	1339,20	0,00	0,00
HtRec	0,00	0,00	0,00	0,00	0,00
ClRec	0,00	0,00	0,00	0,00	0,00
HtCoil	1166,85	1397,82	1484,72	0,00	0,00
ClCoil	0,00	0,00	0,00	0,00	0,00
Humidif	0,00	0,00	0,00	0,00	0,00
FloorHeat	0,00	0,00	0,00	0,00	0,00
FloorCool	0,00	0,00	0,00	0,00	0,00
CentHeatPumpPow	0,00	0,00	0,00	0,00	0,00
CentCoolingPow	0,00	0,00	0,00	0,00	0,00
CentHeatPump	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00

APPENDIX C

Calculation: Hammershus with original wall and heating room

tsbi5 Hammershus uden gammel.disxml (Udstilling) **4.12.2013 13.48 Page 1**

Year 2012, tstep=50, RadModel=Petersen, Options: optimized xsun moist longwsky longwave latheat

Month	Sum/Mean	1	2	3	4	5	6	7
qHeating	4848,10	0,00	0,00	0,00	1602,63	765,16	266,20	95,01
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-12726,88	-59,99	-175,83	-394,72	-1841,15	-2029,48	-1742,38	-1667,81
qVenting	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qSunRad	7279,25	98,91	219,49	464,86	832,29	1211,17	1254,24	1210,06
qPeople	18489,60	0,00	0,00	0,00	2592,00	2678,40	2592,00	2678,40
qEquipment	171,20	0,00	0,00	0,00	24,00	24,80	24,00	24,80
qLighting	3025,89	0,00	0,00	0,00	427,00	428,20	408,61	424,69
qTransmission	-7459,52	-38,92	-43,66	-70,14	-1414,78	-970,87	-963,57	-1001,50
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	-13627,65	0,00	0,00	0,00	-2222,00	-2107,38	-1839,09	-1763,65
Sum	0,00	-0,00	-0,00	0,00	-0,00	0,00	0,00	-0,00
tOutdoor mean(℃)	7,7	-0,5	-0,8	1,7	5,6	11,3	15,0	16,4
tOp mean(℃)	12,1	-0,3	-0,1	3,2	13,2	19,6	22,4	23,3
AirChange(/h)	2,2	0,7	0,7	0,7	3,2	3,2	3,2	3,2
Rel. Moisture(%)	44,2	82,0	82,1	75,6	25,1	18,2	17,9	18,1
Co2(ppm)	443,0	350,0	350,0	350,0	512,9	509,1	507,7	507,2
PAQ(-)	0,9	1,0	1,0	1,0	1,0	0,8	0,7	0,6
Hours > 21	1910	0	0	0	13	213	421	572
Hours > 26	336	0	0	0	0	23	106	127
Hours > 27	188	0	0	0	0	2	79	72
Hours < 20	6431	744	696	744	696	448	190	79
FanPow	9244,80	0,00	0,00	0,00	1296,00	1339,20	1296,00	1339,20
HtRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
ClRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HtCoil	7306,65	0,00	0,00	0,00	1308,12	1049,31	829,29	751,08
ClCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Humidif	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorHeat	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorCool	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPumpPow	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCoolingPow	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPump	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

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Year 2012, tstep=50, RadModel=Petersen, Options: optimized xsun moist longwsky longwave lath

Month	8	9	10	11	12
qHeating	126,14	720,62	1272,35	0,00	0,00
qCooling	0,00	0,00	0,00	0,00	0,00
qInfiltration	-1619,92	-1538,46	-1428,01	-209,63	-19,50
qVenting	0,00	0,00	0,00	0,00	0,00
qSunRad	957,04	572,94	271,23	118,76	68,27
qPeople	2678,40	2592,00	2678,40	0,00	0,00
qEquipment	24,80	24,00	24,80	0,00	0,00
qLighting	434,40	435,70	467,30	0,00	0,00
qTransmission	-859,51	-998,25	-1140,43	90,87	-48,76
qMixing	0,00	0,00	0,00	0,00	0,00
qVentilation	-1741,35	-1808,55	-2145,63	0,00	0,00
Sum	0,00	0,00	0,00	-0,00	0,00
tOutdoor mean(℃)	16,2	12,5	9,1	4,8	1,5
tOp mean(℃)	22,9	18,9	14,8	5,7	1,5
AirChange(/h)	3,2	3,2	3,2	0,7	0,7
Rel. Moisture(%)	17,7	20,8	22,5	73,5	77,2
Co2(ppm)	507,5	509,7	512,1	350,0	350,0
PAQ(-)	0,7	0,8	1,0	1,0	1,0
Hours > 21	584	107	0	0	0
Hours > 26	80	0	0	0	0
Hours > 27	35	0	0	0	0
Hours < 20	94	532	744	720	744
FanPow	1339,20	1296,00	1339,20	0,00	0,00
HtRec	0,00	0,00	0,00	0,00	0,00
ClRec	0,00	0,00	0,00	0,00	0,00
HtCoil	774,21	1163,70	1430,94	0,00	0,00
ClCoil	0,00	0,00	0,00	0,00	0,00
Humidif	0,00	0,00	0,00	0,00	0,00
FloorHeat	0,00	0,00	0,00	0,00	0,00
FloorCool	0,00	0,00	0,00	0,00	0,00
CentHeatPumpPow	0,00	0,00	0,00	0,00	0,00
CentCoolingPow	0,00	0,00	0,00	0,00	0,00
CentHeatPump	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00

Calculation: Hammershus with original wall and heating room

tsbi5 Hammershus uden gammel.disxml (Udstilling) **4.12.2013 13.38 Page 1**

Year 2012, tstep=50, RadModel=Petersen, Options: optimized xsun moist longwsky longwave latheat

Month	Sum/Mean	1	2	3	4	5	6	7
qHeating	4499,44	0,00	0,00	0,00	1569,32	677,23	205,70	56,96
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-13814,99	-70,70	-179,82	-435,35	-2020,90	-2197,20	-1886,41	-1807,08
qVenting	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qSunRad	7279,66	98,92	219,50	464,89	832,34	1211,23	1254,30	1210,13
qPeople	18489,60	0,00	0,00	0,00	2592,00	2678,40	2592,00	2678,40
qEquipment	171,20	0,00	0,00	0,00	24,00	24,80	24,00	24,80
qLighting	3024,70	0,00	0,00	0,00	427,00	427,80	408,60	424,10
qTransmission	-2456,45	-28,22	-39,68	-29,54	-584,42	-142,06	-268,02	-348,92
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	-17193,16	0,00	0,00	0,00	-2839,34	-2680,19	-2330,18	-2238,39
Sum	0,00	0,00	0,00	-0,00	0,00	-0,00	0,00	0,00
tOutdoor mean(℃)	7,7	-0,5	-0,8	1,7	5,6	11,3	15,0	16,4
tOp mean(℃)	12,5	-0,3	-0,1	3,4	14,0	20,3	23,0	23,9
AirChange(/h)	2,2	0,7	0,7	0,7	3,2	3,2	3,2	3,2
Rel. Moisture(%)	43,7	81,5	81,9	75,2	24,3	17,6	17,4	17,6
Co2(ppm)	442,7	350,0	350,0	350,0	512,3	508,6	507,2	506,8
PAQ(-)	0,9	1,0	1,0	1,0	1,0	0,8	0,7	0,6
Hours > 21	2172	0	0	0	21	270	490	626
Hours > 26	454	0	0	0	0	32	138	161
Hours > 27	296	0	0	0	0	22	97	110
Hours < 20	6151	744	696	744	672	384	145	53
FanPow	9244,80	0,00	0,00	0,00	1296,00	1339,20	1296,00	1339,20
HtRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
ClRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HtCoil	7302,27	0,00	0,00	0,00	1307,71	1048,65	828,50	750,05
ClCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Humidif	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorHeat	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorCool	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPumpPow	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCoolingPow	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPump	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

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Year 2012, tstep=50, RadModel=Petersen, Options: optimized xsun moist longwsky longwave l

Month	8	9	10	11	12
qHeating	90,48	636,18	1263,57	0,00	0,00
qCooling	0,00	0,00	0,00	0,00	0,00
qInfiltration	-1757,94	-1664,05	-1577,92	-207,03	-10,58
qVenting	0,00	0,00	0,00	0,00	0,00
qSunRad	957,09	572,97	271,25	118,77	68,27
qPeople	2678,40	2592,00	2678,40	0,00	0,00
qEquipment	24,80	24,00	24,80	0,00	0,00
qLighting	434,20	435,70	467,30	0,00	0,00
qTransmission	-215,25	-361,88	-469,04	88,27	-57,69
qMixing	0,00	0,00	0,00	0,00	0,00
qVentilation	-2211,77	-2234,92	-2658,36	0,00	0,00
Sum	-0,00	-0,00	-0,00	0,00	0,00
tOutdoor mean(℃)	16,2	12,5	9,1	4,8	1,5
tOp mean(℃)	23,5	19,5	15,5	5,6	1,5
AirChange(/h)	3,2	3,2	3,2	0,7	0,7
Rel. Moisture(%)	17,2	20,2	21,8	72,7	76,9
Co2(ppm)	507,0	509,3	511,6	350,0	350,0
PAQ(-)	0,6	0,8	0,9	1,0	1,0
Hours > 21	616	149	0	0	0
Hours > 26	123	0	0	0	0
Hours > 27	67	0	0	0	0
Hours < 20	68	449	732	720	744
FanPow	1339,20	1296,00	1339,20	0,00	0,00
HtRec	0,00	0,00	0,00	0,00	0,00
ClRec	0,00	0,00	0,00	0,00	0,00
HtCoil	773,39	1163,22	1430,75	0,00	0,00
ClCoil	0,00	0,00	0,00	0,00	0,00
Humidif	0,00	0,00	0,00	0,00	0,00
FloorHeat	0,00	0,00	0,00	0,00	0,00
FloorCool	0,00	0,00	0,00	0,00	0,00
CentHeatPumpPow	0,00	0,00	0,00	0,00	0,00
CentCoolingPow	0,00	0,00	0,00	0,00	0,00
CentHeatPump	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00