A phenomenological study of innovative strategies for building upgrade and their architectural use to achieve a new intensified atmosphere in the existing urban heritage

TU Delft Heritage & Architecture

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To my parents
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INTRODUCTION

“Shields of rationality”
Objective claims and rhetoric to ground and justify architectural design
1.1 - ARCHITECTURAL RHETORIC

The position paper reflects on the trend followed by architects to explain and justify the choices they make during the design process with objective reasons to ground them on a solid basis and make the clients and the public agree with them.

In fact, architecture is a public art and it is thus subjected to the acceptance of the collective that will live within it as well as of clients that will finance its construction. Therefore, architects have struggled over the centuries to find a series of ways to ground and justify their aesthetic choices, making them understandable and generally accepted.

In this respect, it is possible to state that architecture is treated like a product to be advertised and sold on the market, with architects striving for acceptance and describing their subjective choices with a rhetoric aiming at presenting their design as a rational consequence directly and inevitably deriving from objective reasons.

As argued by Geoffrey Scott, “the great variability of taste forces us to reduce it”, since only by reducing it in terms of something more constant and reliable - for instance functional, technical, scientific or environmental reasons - we are able to control it, to explain it and to justify our aesthetic choices to others. (1)

This “reduction of taste” through objective justifications is deeply related to the issues characterising the particular character of each epoch and society.

Therefore, it is possible to notice how today ecology and sustainability have become the reference points to which the majority of architectural projects seems to be related to.

In fact, as argued by Charles Jencks, “the progressive decline faced by religion and its substitute metanarratives generated a void which drives the architect every-which-way in search of credible alibis - functional, ecological, urban and technical - that could legitimate great costs and fearsome gestures”. (2)

Furthermore, the interpretation of architecture as a rhetorical discipline is related to the ideas of the French philosopher Bruno Latour concerning his discourse upon the rhetoric of science and the notion of the “complete implausibility” of the social explanation of scientific facts. (3)

In particular, he describes how scientists have tried to explain scientific objects as deriving from “matters of fact”, whereas, as he argues, they should be explained as a consequence of “matters of concern”.

Thus, the rational explanation of science should not be based on fixed objective points on which to ground a theory, but on a theory, derived form a matter of concern, that should be then grounded and defended with a series of arguments, as happens with architectural design. Therefore, the Archimedean statement “give me one fixed point and I will move the Earth” becomes “give me one matter of concern and I will show you the whole earth and heavens that have to be gathered to hold it firmly in place”. (4)
In this respect, it is possible to maintain that the “social construction of scientific facts” as well as the social explanation of architectural facts cannot be related to any undeniable truth since no argument could never be able to guarantee an absolute degree of rightness. For this reason, knowledge can be interpreted as a fabrication, and the difference between objectivity and subjectivity characterizing architecture becomes superfluous since absolute objectivity does not exist.

As stated by Latour, “facts are made up, there is no such thing as natural, unmediated, unbiased access to truth, we are always prisoners of language, we always speak from a particular standpoint”. (5)

1.2 - THE ROOTS OF ARCHITECTURAL RHETORIC

Functionalism and the Modern Movement

As explained by the philosopher Alain de Botton, it is possible to notice a difference between the way architects design and the way in which they describe their architectural works, with a rhetoric based on objective justifications playing a fundamental role in the presentation of their projects.

In this respect, it is possible to maintain that this statement applies particularly well to the architects of the Modern Movement. In fact, it might be argued that, even if they designed “with beauty in mind”, they described their work as a purely scientific and reasoned approach since these objective grounds were more efficient to convince their clients and face criticisms. (6) Thus, even if the goal of the Modernist architect was to create what he considered as a beautiful environment capable of hosting a modern way of life, his description of the design suggested a more objective and rational interpretation of his projects.

Furthermore, as stated by MIT Professor of History and Architecture Stanford Anderson, it is possible to argue that this method of justifying subjective aesthetical choices with objective and technical reasons brought to a misunderstanding of Modernist practice which, by being simplistically labelled “functionalistic”, explained this kind of architecture as a direct consequence of the requirements of function and reason.
In fact, this way of interpreting the architecture of the Modern Movement is a superficial one since their work addresses more than only issues of function by being directly related to a deep understanding of architecture, life, beauty and other irrational determinants capable to influence the generation of the architectural shape. (7)

In particular, this dualism between the “objective” and the “subjective” is deeply rooted in the very nature of architecture, a discipline capable to blur the boundaries between rationality and irrationality, technology and aesthetics, and to create a meaningful relation between these apparently opposite realms.

However, when architects present and describe their projects to their clients or the general public, the subjective and irrational dimension of the discipline is often neglected - you will hardly never hear an architect say “I designed it this way because I thought it looked beautiful” - in favour of an explanation of the design choices based on more objective reasons to which it would be much easier to agree upon, augmenting the probabilities to sell their work on the “market”.

1.3 - ARCHITECTURAL RHETORIC TODAY

The hegemony of sustainability and ecology

The discourse upon architectural sustainability is considered one of the most pressing issues of our time. In fact, phenomena such as climate change, the greenhouse effect and the harmful consequences of the use of fossil fuels suggest to reconsider the way we use our energy, especially in buildings.

In particular, this prominent role in economical and societal issues makes ecology and sustainability interpretable as the new “objective divinities” providing architectural gestures a shield of rationality capable to shape and justify contemporary design.

In this respect, it is interesting to notice the way a renown office such as Foster & Partners uses to explain one of their projects - in this case the 30 St. Mary Axe skyscraper, built in London between 1997 and 2004 - by using ecology as a collectively accepted justification for the shape of the building, as well as an active parameter determining the design process.

In fact, the design team labels it as “London’s first environmental skyscraper”, claiming that it saves up to 50% the energy required by other buildings of comparable size in London, thus assigning to the environmental strategy a primary role in the determination of the design.

In the description of the project it is stressed how the shape is derived by a series of wind studies and aerodynamic diagrams, aiming at
Reducing the building’s opposition to wind forces. In this way, the lateral load on the structure is greatly reduced, and this made it possible to have smaller floor beams and a core which did not need to be braced, resulting in a column-free interior space. Moreover, this shape allows the building to avoid the reflection of winds on the ground level, creating a more friendly environment for pedestrians. (8)

Furthermore, it is emphasized how the presence and the design of the six-storey-high vertical atria defining the interior of the building are derived by their capability to improve the quality of the interior environment by providing light and natural ventilation. In fact, these “green lungs” reduce the load on the mechanical ventilation system and, during the 40% of the year, when the atmospheric conditions allow, make it possible to ventilate the building only by natural means. Moreover, this spiralling spaces contribute to create a better working environment by acting as “light wells”, thus providing natural light also in the deepest parts of the floor plans, and constituting important meeting points for the social interaction between colleagues. (9)

For these reasons, it is possible to interpret the building as a manifesto of the condition of the contemporary architect who takes refuge in the domains of ecology and sustainability to ground, shape and justify his design choices and make them collectively accepted.

Next: St. Mary Axe wind loads and passive ventilation schemes
1.4 - THE FUTURE OF ARCHITECTURAL RHETORIC

Subjectivity and objectivity

It is possible to argue that the position of the contemporary architect is characterised by the trend to merge subjective and objective, rational and irrational, functional and aesthetic dimensions in the design process, which, however, will then be ultimately explained and represented as a direct consequence of mainly objective reasons. Nevertheless, it is possible to maintain that the distinction between objectivity and subjectivity is a feeble one for the intrinsic difficulty of providing a neat definition of these two domains.

In fact, as explained in the previous sections, the notion of knowledge as a fabrication derived form personal interpretation makes the ideas of undeniable truth and absolute objectivity inconceivable. Furthermore, contemporary techniques like parametric design have shown to be capable of creating a process where the objective and the subjective are so deeply interrelated that it almost impossible to distinguish them. Therefore, it is possible to consider the connotations of “subjectivity” and “objectivity” as a consequence deriving by our still incomplete understanding of the processes characterising our capability to create or to feel emotion.

Thus, it is reasonable to maintain that if we will ever find the explanation to the nature of these processes this differentiation between rational and irrational will become superfluous and out-of-date, creating a condition that might change the way future architects will design as well as describe, justify and ground their creations.

“The things by which our emotions can be moved - the shape of a flower or a Grecian urn, the way a baby grows, the way the wind brushes across your face, the way clouds move, their shapes, the way light dances on the water, or daffodils flutter in the breeze, the way in which the person you love moves their head, the way their head follows that movement, the curve described by the dying fall of the last chord of a piece of music - all these things can be described by the complex flow of numbers. That’s not a reduction of it, that’s the beauty of it.”

(Douglas Adams)
1.5 - GRADUATION PROJECT

The arguments analysed in the previous paragraphs demonstrated how the interconnection of the subjective and the objective realms of architecture is a characteristic derived by the twofold nature of a discipline capable to blur the lines between the rational and the irrational, while searching for a balance between these opposite forces. As beautifully summarized by Robin Evans, architects are dealing with a “compelling game between form and function, meaning and purpose, symbol and utility, commodity and delight - up on one side and down to the other”. (10)

In this respect, it has been examined how the irrational side is often neglected in the architects presentation and description of their projects, with an explanation of the design choices which makes them appear as if exclusively and inevitably derived from objective grounds.

In particular, the arguments emphasized how ecology and sustainability, because of their prominent position in today’s economical and societal discourses, have been identified as the main actors providing objective bases on which to ground contemporary architecture designs.

The capability of sustainability to influence, determine, ground and justify the practice of the contemporary architect is affecting considerably the methods and tools which have been applied in this graduation project.

In fact, the thematic research informing the design is greatly influenced by the current problem of energy efficiency and sustainability since it reflects on the possibilities and challenges derived from the application of sustainability upgrade strategies on existing buildings and the way they could influence the technical and architectural tolerance for change of the historic city.

The design focuses on establishing a connection between the technical aspects characterizing these innovative strategies for building upgrade, with an approach based on phenomenology, thus characterized by the more intangible goal to create a new intensified atmosphere, a new feeling in the existing context derived by a transformation of the old which follows from the interpretation and empowerment of its architectural and sensorial qualities, producing a new enhanced experience of the place.
THEORETICAL FRAMEWORK

Problem statement and research question
2.1 - THE NEED TO REDUCE ENERGY DEMAND

The discourse upon architectural sustainability is considered one of the most pressing issues of our time. In fact, phenomena such as climate change, the greenhouse effect and the harmful consequences of the use of fossil fuels suggest to reconsider the way we use our energy, especially in buildings.

As pointed out in the book “Reimagining the Envelope” - a study by Ulrich Knaack, Thaleia Konstantinou, Marcel Bilow and Bert Lieverse published by the Delft University of Technology in 2012 - according to European Union statistics the consumption of energy is the main factor in the production of greenhouse gases (59.8%), followed by transport (19.5%), agriculture (9.2%), industrial processes (8.5%) and waste (2.8%). Therefore, a reduction in the energy usage would play a major role in the reduction of carbon dioxide (CO$_2$). (1)

Furthermore, as shown by 2010 Energy Star statistics, it is possible to notice how the building sector represents the biggest energy user, being the cause of the 40% of European energy usage. In this respect, as stated by the International Energy Agency, the building sector represents the most cost effective sector in the reduction of energy consumption, with an estimated potential of 1.509 million tons of oil equivalent by 2050. It has also been emphasized how improving energy efficiency in buildings can significantly reduce CO$_2$ emissions, with a calculated possible mitigation of 12.6 giga tons of emissions by 2050. (2)

Therefore, a series of norms and common goals has been established by the European Union in the past few years. For instance, in 2010 the members signed a directive commanding that new buildings should be low or zero energy buildings. Moreover, in March 2011 the European commission established the common goal to reduce the energy emissions of the building sector of 53% by 2030 and 91% by 2050. (3)

For these reasons, our task as contemporary architects should be to study and apply a series of strategies capable to ensure the sustainability of new constructions as well as the upgrade of our existing building stock to future standards of comfort and energy efficiency.

Above: Energy Usage by Sector (Energy Star Statistics 2010)
2.2 - RELEVANCE

The need to reduce energy demand examined in the previous page is suggesting to actively intervene on the historical heritage with the aim to reconsider the way energy is used in historical buildings by making them up to date with the contemporary standards of comfort and energy efficiency.

In this respect, as described in “Reimagining the Envelope”, the relevance of the upgrade of our existing building stock is threefold.

First of all, the importance of this operation is ecological, since it has been proven that a reduction of the energy demand of existing buildings will result in a diminution in the emission of greenhouse gases and pollutants.

Moreover, another factor influencing the need to intervene on the existing is derived by the fact that the renewal rate of the building stock is very slow - it has been calculated that only 1% on new constructions is added per year - and therefore in 10 years time only 10% of the buildings will meet the requirements for energy efficiency if we only focus on new constructions. (4)

Furthermore, studies have proven that the environmental impact of the life extension of the existing is less than demolition, because by demolishing, the embodied energy of buildings - characterised by the production, transport and assemblage of the construction materials - would be lost.

Secondly, the relevance of building upgrade is economical. In fact, buildings can be considered as a “stored capital”, since the load bearing structure of existent constructions can last for centuries, and therefore demolition would constitute a waste of this capital. (5) Moreover, the lowering of the energy consumption of buildings, in terms of the energy they require for heating, cooling, ventilation and electricity, plays a major role in determining their operational cost.

Finally, and probably most importantly, an upgrade intervention to prolong the life of existing buildings has a cultural and social relevance, since they represent documents of the past constituting fundamental pieces of our collective memory and identity.
2.3 - ARCHITECTURAL RELEVANCE

The challenge to intervene in the historic context

The approach characterizing the graduation project considered the city as a stage, where each building could be associated with an actor playing a role in the testimony of the past, thus characterizing our collective memory and identity. In this respect, the role of the architect in contemporary society should be related to contributing to the preservation of this important societal role of our building fabric and, therefore, to intervene on the existing with the aim of enhancing the character, the architectural quality and the beauty which define it, through the interpretation and understanding of its characteristics and its ultimate transformation.

As explained by the Finnish architect Juhani Pallasmaa: “buildings and towns enable us to structure, understand and remember the shapeless flow of reality and, ultimately, to recognise and remember who we are; architecture enables us to perceive and understand the dialectics of permanence and change, to settle ourselves in the world, and to place ourselves in the continuum of culture”. (6)

In this respect, it is possible to add a further degree of relevance on the discourse regarding the upgrade of existing buildings. This level concerns the architectural relevance of the intervention, which arises when reflecting upon the character of the upgrade operation from the architectural perspective.

In fact, when intervening in the historic context with contemporary strategies of upgrade, a series of challenges arises regarding the possibility and the manner to conjugate the technical upgrade dictated by the demands of the contemporary society with the aesthetics and architectural demands of the historical city, as well as the tolerance for change characterising existing constructions.

In particular, it is possible to reflect on how to intervene on the historic city without compromising the character, the architectural quality and the beauty which define it. Thus, a series of important considerations should be discussed in terms of the way the new is going to relate to the existing and the position that the diverse layers of history would assume towards each other.

Will the new change, revitalise or compromise the character of the old?
Will it be concealed, with the aim of preserving as much as possible the existing situation? Or will it be visible, and a contrast will be established?
Or will a harmony be created between the past, the present and the future?
How could it be possible to conjugate sustainability upgrade with the creation of a beautiful ensemble within the history of the building?

These questions will constitute the basis of the reflection that will arise from this research and the backbone informing and structuring the design.

Next page: the context of the project - the Binnengasthuis area, in the historic centre of Amsterdam
The research question conjugates the personal interest in the upgrading of the historical city examined from the architectural point of view with the brief of the TU Delft Heritage & Architecture studio, consisting in an intervention on the Binnengasthuisterrein, an area located in the historical inner city of Amsterdam. In particular, the research and the design express the interest in conjugating the technical aspects with innovative strategies for the upgrade of existing buildings, with the more intangible goal to create a new intensified atmosphere, a new architectural feeling in the existing context derived by a transformation of the old which follows from the interpretation and empowerment of its qualities.

How will it be possible to use innovative strategies for the technical upgrade of existing buildings to create a new atmosphere arising from the interpretation and intensification of the qualities of the historic context?

How to apply strategies for building upgrade in a phenomenological way, considering their architectural and aesthetical values and their impact on the existing context in terms of its architectural tolerance for change?

How could this approach, apart from improving the technical performance of the considered buildings, be capable of playing a relevant role in the architectural position that will be assumed in terms of preserving, revitalizing, enhancing or redefining the architectural qualities of the site?
3
THEMATIC RESEARCH

Strategies for building upgrade from the architectural perspective
3.1 - STRATEGIES FOR BUILDING UPGRADE

The research focuses on the examination of the strategies of building upgrade to contemporary standards of energy efficiency and comfort, individuated by Thaleia Konstantinou in her Phd work “Facade refurbishment toolbox - supporting the design of residential energy upgrades”. In the following section, the strategies - addition inside, replacement, addition outside, covering and networking - will be analysed considering their technical and, in particular, their architectural values.

The more strictly “technical” part of the analysis will concern the advantages these operations are able to bring to existing buildings, the parameters they require in terms of structural and material tolerance for change, and the state of the art techniques with which they can be carried out.

Moreover, the analysis will focus on the possibilities offered by the strategies to improve the energy efficiency of the historic buildings by influencing their capabilities of saving, storing and producing energy. Furthermore, the strategies will be examined with a phenomenological approach, focusing on the ways their “architectural” characteristics, can be used in the historic context to preserve, revitalize, enhance or redefine the architectural qualities of the historical heritage. Therefore, a series of considerations will have to be made in terms of the way these operations can influence the appearance, the atmosphere, the character and the meaning of the existing buildings. In this respect, a series of architectural themes will be analysed together with case studies to explain and underpin the statements that will be made on the architectural and aesthetical use of the strategies.

The choice of the case studies is determined by the attempt to show archetypical examples on the way a particular strategy is used, analysing and understanding the ideas behind their application so to be able to translate them in a meaningful way to the design process that will be carried out in the graduation project.

As the case studies will show, the strategies are able to determine a powerful influence on the way the architecture of the existing is treated, emphasizing different ways to deal with our heritage by describing both concealed interventions and projects focused more on historical preservation, as well as designs which actively intervene and modify the existing by creating a new powerful contrast or an harmonic ensemble between old and new.
CASE STUDIES: the architectural perspective of the upgrade strategies examined through archetypical examples

<table>
<thead>
<tr>
<th>ADDITION INSIDE</th>
<th>REPLACEMENT</th>
<th>ADDITION OUTSIDE</th>
<th>COVERING</th>
<th>NETWORKING</th>
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<tbody>
<tr>
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<td>RECONSTRUCTION</td>
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<tr>
<td>De Koningsvrouwen v.L. Archivolt Architecten</td>
<td>The White House Bendheim Restoration</td>
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<td>British Museum Foster &amp; Partners</td>
<td>Villa Flora Jón Kristinsson</td>
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<tr>
<td>EXPOSED</td>
<td>JUXTAPOSITION</td>
<td>NEW BODY</td>
<td>ENERGY PRODUCTION</td>
<td>SYNERGETIC CAMPUS</td>
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</table>
3.2 - ADDITION INSIDE

Description

The strategy aims at improving the performance and comfort of buildings by increasing their thermal resistance, with the objective of minimising heat losses and thermal bridges. In this way, the energy efficiency will be augmented since there will be less need for heating in the winter and for cooling in the summer. Since the strategy is concentrated on the interior part of the building, the external appearance will be left unchanged.

As explained by Thiemo Ebbert in his PhD work “Re-face - refurbishment strategies for the technical improvement of office façades”, this strategy presents three main kinds of intervention.

1. Addition of an internal layer of insulation
   A layer of insulating material is added to the existing walls. This option presents a series of technical risks because it is not always able to solve all thermal bridges and it requires special attention for the formation of condensation and moulding in the new insulation layer, in particular on the edges of window frames. To prevent this from happening, the layer of insulation has to be sufficiently thick, and a series of considerations has to be made concerning the consequences that changing the width of the existing wall could have on the interior proportion and layout of the building.

2. Additional interior layer: interior layer non-insulated
   A new non-insulated layer is added on the interior of the building; in this way, both the new and the existing layers will work in combination and will provide the performance and function of an exhaust facade.

3. Additional interior layer: interior insulated facade
   The new facade created by the existing layer and by the new internal insulated layer functions as a box window, creating a new environment in the building. In this way, the strategy is able to solve thermal bridges and eliminating heat losses on the facade. Since the interior layout will be completely revolutionised, a series of considerations regarding the tolerance for change of the architecture of the existing building will have to be made.

1. Addition of an internal layer of insulation
2. Addition of a new internal façade
3. Box in the box configuration A
4. Box in the box configurations B
Materials and state of the art techniques

The insulation of buildings aims at harvesting energy saving by avoiding thermal exchanges between the inside and the surrounding environment.

It can be done with a series of conventional materials such as cellulose fibre, glass wool fibre, rockwool, polystyrene or phenolic foam, each with different performance characteristics that ultimately define the thickness required by the insulation layer. In historical buildings, a proper insulation layer is often absent, and the actual insulation activity is carried out through the mass of the walls.

In contemporary practice, a series of new materials allows a higher insulation efficiency and gives the architect the opportunity to achieve the same performance with thinner layers of insulation, as shown by the graph on the right. These materials will be briefly described.

- Vacuum insulation panels
They consist of a nearly gas-tight enclosure surrounding a rigid core, from which the air has been evacuated. The core is usually of fumed silica, cased in aluminium and plastic. The vacuum practically eliminates convection and it also greatly reduces conduction, as there are far fewer collisions between adjacent gas molecules. For these reasons, they allow for a better insulation than conventional materials.

Their advantages are high thermal performance, limited construction thickness and relative lightweight, whereas disadvantages regard their fragility, limited service life, inherent thermal bridges and cost.

- Aerogels
Aerogel are defined as synthetic solids that consist almost entirely of air. They have the lowest density among all the known solids. Because of their low density, they have extremely low thermal conductivity, and thus provide very high thermal insulation. Their advantages are represented by their high thermal performance, limited construction thickness, as well as the fact that they are workable, breathable and recyclable. Their main disadvantage is the very high cost.

- Dynamic insulation and switchable insulation
In this kind of insulation, cool outside air is able to flow through the thermal insulation layer of the building and, by picking up the heat from the insulation fibres, it is able to enter the building as preheated air. The connotation of dynamic insulation derives from the fact that the transmission heat loss (U-value) is no longer constant but varies with the speed of the air flowing through the insulation. The advantages of dynamic insulation consist in providing natural ventilation without draft problems, high thermal performance, and less risk of condensation. On the other hand, the disadvantages regard the collection of small particles in the insulation material, which can lower its performance, and mostly the fact that openable windows will not be allowed in this kind of construction.

Switchable insulation is a type of insulation which is capable to adapt depending of the current thermal needs of the building. Therefore it will allow for heat exchanges between the interior and the surrounding environment when there is need to cool the building, whereas in the winter it will seal the interior by reducing heat losses at the minimum.
**Architectural characteristics**

Adding insulation inside is a strategy often applied to listed monuments when the priority is to upgrade the building while maintaining its external appearance unchanged. In fact, it is possible to perceive it as a concealed intervention because it is not visible from the outside and therefore capable to preserve the original exterior historical character of the building.

However, even in the case of adding a thin layer of insulation inside, the internal appearance of the building will change, since the original walls will no longer be visible and the new walls will be thicker, changing therefore the proportions of the spaces and the rhythm of the openings.

Moreover, in the cases of designing a more active intervention such as the addition of an interior facade, until the extreme cases of the box in the box and the gable, the interior layout of the building will be completely altered by the insertion of a new body inside the building.

Therefore, in considering the interior layout, a series of choices will have to be made regarding how much the designer wishes for the intervention to be visible and to play an active role in the reconfiguration of the building.

In this respect, in the case of adding a layer of insulation to the wall, the choice of the insulation technique and material will be able to influence the thickness of the layer and its performance, whereas the type of interior finishing will defined the new appearance of the wall in terms of material, texture and colour.

On the other hand, the insertion of a new facade will completely redefine the way the building is perceived from the inside, being able to create a new atmosphere, a new character derived from a new cooperation between old and new. In this case, an infinite array of possibilities regarding the way the new is going to interact with the old as well as their degree of contrast is derived from the architectural choices made in the design.

These choices directly influence an array of architectural themes (see diagrams) which will be able to define the character of the intervention and its relation to the existing building.
De Koningsvrouwen van Landlust, Archivolt Architecten, Amsterdam, Netherlands, 2007-11

[A concealed upgrade intervention of combining techniques]

The existing building, “De Koningsvrouwen van Landlust” was built between 1932 and 1938 designed by architect Gerrit Versteeg (1872-1938).
It was granted the status of listed monument and symbolizes one of the first open block allotments in Amsterdam. However, after 70 years of construction, the apartments no longer satisfied the requirements for “fire safety, energy consumption, health and housing typology”, and therefore renovation was needed. (11)
Therefore, the aim of the intervention was to upgrade the building in terms of its comfort and energy efficiency performances, while preserving its historical appearance as a building from the 1930s which played an important role in the history of urban development in Amsterdam.
In this respect, a series of techniques has been applied in combination for the upgrade of the complex. First of all, a new layer of insulation has been added on the interior walls, improving the thermal performance of the building while leaving the exterior appearance unchanged. In this case, it is possible to define the intervention as a “box in the box”, since each apartment is enclosed in a 50mm layer of insulation made of rockwool, which passes through the perimeter walls, ceilings and floors of each flat.
Moreover, the windows have been replaced with specially designed aluminium window frames to restore the image of the original steel frames while improving their performance.

In addition, the building was provided with a ceiling heating and cooling system, underground heat storage and ventilation with heat recovery. Furthermore, energy is produced by PV panels placed on the roof.

It is possible to define the intervention as concealed since, even if the interior proportions of the apartments slightly change with the application of the “box in the box” insulation layer, and even if the windows are replaced and other devices such as PV cells are added, these interventions remain hidden and the overall external appearance of the existing building still declares the maintenance of its historic character and value as the priority of the design.
New window

New window frame

Old brick facade

PIR insulation layer (60mm)

Rockwool insulation (50mm) sandwiched in steel panels

Gypsum panel (12.5mm)

Waterproofing

Wooden windowsill

Wooden support

Ceiling heating and cooling system with PV

Box in the box apartments

Heat pump

Left: pictures and details of the insertion of the new isolation layer

Right: section with upgrade intervention
Baco Factory, Satijnplus Architecten, Roermond, Netherlands

[An exposed intervention creates a new atmosphere in the interior]

The factory was built in 1905 and it is part of the cultural heritage of Roermond, as well as being a national monument. During its history it housed a flour mill, a bicycle factory, a cigar factory and a furniture company. The building is a beautiful example of the typology of an old factory and its value is addressed considering it as a document representing the history of structural engineering, with the special use characteristic of materials such as brick and glass and the particular relation between inside and outside. After almost a century after its construction, the building was in a state of decay and therefore an intervention was needed. When the housing corporation Wonen Limburg decided to make it the new location for their offices, the aim of the project was to preserve and revitalize this important historical monument, while upgrading its performance to modern standards of comfort and energy efficiency.

Since in this case the priority was to preserve the external appearance of the building and because of the relative freedom and flexibility allowed by the interior layout of a factory typology, the solution was found in the addition of an interior non-insulated facade, placed at almost 1m from the existing brick facade.

The old and new facades work in combination to improve the insulating performance of the building by reducing heat losses and thermal bridges. Moreover, the void between the new and the old layers creates a buffer zone which helps in lowering the energy load required for cooling during summer, by creating vertical ventilation, as well as the need for heating during winter, constituting a preheated zone by making use of the air stack effect as well as the greenhouse effect. In addition, the cavity is also used for the placement of escape routes and distribution channels.

The intervention completely redefines the interior atmosphere of the building by exposing the new insertion, while trying to establish a communication and a certain harmony between old and new with designing the new steel and glass layer in relation to the rhythm of the existing brick facade.
Situation: The factory is built in 1905 in a traditional style. At first, the building was a flour factory. Then it became The First Dutch Bicycle factory. At the end the Roermond coffee roaster factory used the building.

Context: Housing corporation Wonen Limburg was looking for a new location for their office. They preferred an existing building of cultural heritage. The BACO factory is an example of the typology of old factory buildings. The architecture and historical values are determined by the particular importance of the object for the history of structural engineering, the use of materials and the special relationship between exterior and interior. The building is a national monument.

Intervention: The new thermal envelope is placed at some distance behind the old brick facade. This creates a large cavity, where the escape routes and distribution channels are included. The harsh climate in the cavity forms a heat buffer between inside and outside. A first step towards an energy-neutral building.

The cast iron columns support the replacement wooden beams of the floor. The climate ceilings with the installations for air exhaust and heating are installed between the beams, so that the rhythm of the beams is equal to the 1905 building.

Position architect: Preservation of the facade of the building

Own position: This is an extreme way of preserving an old facade. From the outside the building is not changed, while from the inside there is a completely different world. I think the intervention should be in harmony with the inside and outside.
3.3 - REPLACEMENT

Description

The strategy consists of the removal of building elements which do not function anymore for aesthetical or technical reasons, followed by their replacement with new ones.

Depending on the level of the refurbishment, the intervention can range from partial removal, when windows or small facade elements are replaced, to the extreme of the complete removal of the old facades - an operation which leaves intact only the load bearing structure of the original building - and their consequent replacement with new ones. When considering scenarios of replacement strategies in existing historical buildings and listed monuments, the most common approach consists in the replacement of out-of-date single pane glazing with more advanced glass techniques. In fact, it is acknowledged that the old single glass panes characterising traditional windows are no longer acceptable in terms of contemporary standards of performance for energy efficiency and comfort and therefore an upgrade of this kind of element is needed. In this respect, the new window replacing the old one has to be able to improve the thermal insulation of the building, and - by consequently reducing the amount of heat losses in winter and heat gains in summer characterising single pane glass windows - the overall energy efficiency of the complex.

In particular, it is possible to state that the way in which this replacement will be carried out constitutes an important architectural statement influencing the future history of the existing building.

In fact, when considering the replacement of building elements, a series of architectural considerations arises regarding the type of approach that the architect is going to adopt.

One kind of intervention is a consequence of the will to preserve the original appearance of the building; this results in the replacement of the old window with a new one which mimics the original and produces an overall feeling of unchanged historical appearance. This operation is directly related to interventions concerning the reconstruction of historical buildings, attempting at restoring as much as possible the original appearance of the existing artefact.

When considering this kind of approach a series of question arises regarding how to reconstruct in a historical way a particular building element.

In fact, especially when the history of the building is constituted by different historical layers - as it is often the case with the complex biographies of the buildings in Amsterdam - a choice will have to be made regarding to which one of these layers the reconstruction will be related to and to which degree the new element will mimic history. Moreover, in the case of reconstruction a conundrum regarding the “authenticity” of the new intervention is produced by the fact that the new design will be faking history pretending to be of an epoch different from its own.

However, it is also possible to state that this kind of “concealed” approach remains of great interest for its capability to make possible the replacement of building elements without compromising the appearance of the historical building.
On the other hand, another type of approach is to make the intervention visible and in this case an infinite series of options regarding the way new and old could be combined is the main protagonist in characterising the new appearance of the building. Will the new produce a neat contrast with the old or will it aim at creating a new harmony between the two stages of the history of the building? How could the new intervention be capable to achieve such diverse goals?

In this respect, this section will present an analysis of the state of the art techniques for the realisation of energy efficient windows, followed by a reflection on the architectural themes connected to these kinds of operations. Then, the section will conclude with an examination of case studies demonstrating the influence architectural themes in the execution of window replacements which aim at mimicking history or at inserting a new layer establishing a communication - harmonious or contrasting - with the existing building.

**Materials and state of the art techniques**

- **Restoration glass**
  Restoration glass (or monumental glass) is a glass with historical appearance, capable of achieving contemporary standards of performance in terms of comfort and energy efficiency while resembling glass made before the diffusion of modern window glass technology. In particular, this technique mimics the window features “that helped set the character of old museums, monuments, railway stations, market places and churches; this glass will literally help classical monuments remain classic” (14)

- **Storm windows**
  “Storm windows are windows that are mounted outside or inside of the main glass windows of a house and they serve as a retrofit on existing windows in order to improve their thermal efficiencies.” (15)

- **Double and triple glazing**
  “Insulated glazing, are double or triple glass window panes separated by an air or other gas filled space to reduce heat transfer across a part of the building envelope.” (16)

- **Vacuum insulation glass**
  It consists of two glass panes with a vacuum created between them to increase the assembly’s thermal resistance. The vacuum allows for virtually no conduction or convection of heat between the two panes, because there is no gas to act as a medium for heat transfer, therefore it achieves up to 1/7 the thermal conductivity of conventional insulating materials. (17)
- **Self-cleaning glass**
  It is divided into hydrophobic and hydrophilic type of self-cleaning glass. Both types clean themselves through the action of water, the former by rolling droplets and the latter by sheeting water that carries away dirt. \(^{(18)}\)
  By decreasing the need for the maintenance and the cleaning of windows this devices are able to improve the overall efficiency of the building.

- **Photochromic glass**
  It is a type of glass that exploit UV-light to modify the molecular structure of the glass pane and therefore it is able to change its degree of transparency according to the quantity of light projecting onto it. \(^{(19)}\)

- **Thermotropic glass**
  A type of glass which changes its characteristics of translucency, depending on temperature. When exposed to low temperatures, it presents a perfect mixture of components, whereas, at high temperature these components are separated and produce shading. The construction is based on two panes of glass enclosing a polymer gel that at a certain temperature changes from being transparent to opaque. \(^{(20)}\)

- **Electrochromic glass**
  It is a glass that change its state from transparent to opaque in when subjected to voltage. In particular, when electricity is applied, the electrochromic material enclosed by the glass panes changes from a coloured, translucent state, usually blue, and a transparent state. \(^{(21)}\)

- **Liquid crystals and suspended particle devices**
  They constitute another kind of glass that change its property of transparency following an application of voltage. In particular, when no electricity is applied the liquid crystals enclosed by the window panes are arranged in a random way and therefore scatter some of the light projecting on the window producing as a result a translucent appearance. On the other hand, when voltage is applied the liquid crystals align and, by letting light pass, make the window transparent.

Phase separating glass could be able to augment the overall efficiency of the building by creating a dynamic shading device capable to harvest at best the quality of light while at the same time protect against glaring and overheating problems.
Architectural characteristics

When carrying out the replacement of a building element, in this case of windows, the choices made by the designer will determine whether the appearance of the new element will be historical or contemporary. In particular, the ultimate appearance of the intervention will be directly connected to a series of architectural themes which assume a very important role in the definition of the design approach.

The materialization of the new window derived by the choice of the kind of glass adopted will determine its appearance in relation to the texture and the colour of the historical window. In fact, with the use of a restoration glass it will be possible to mimic the small curves and imperfections characterising traditional glass making techniques, whereas the use of double or triple glazing or phase separating glass will result in colours and textures contrasting from the original.

Furthermore, a very important role will be determined by the design of the new window frames. In fact, the dimensions of the glass spans are linked to the age of the window, because of the difference between contemporary and traditional glass technologies; therefore, smaller spaces between the window frames are related to older periods of time.

For this reasons, when replacing a window, it is possible to mimic the historical window framing with smaller spans between the glass panes or to harvest contemporary technology to achieve windows with uninterrupted glass panes. These choices will have a great influence on the rhythm of the new façade and on the way the new ensemble will be perceived.

In conclusion, it is possible to state that the way the replacement of, in this case, window elements will be executed is directly related to the interpretation of the concept of history made by the designer. In particular, history can be considered as a document of the past that has to be carefully preserved through a concealed intervention, or, on the other hand, as an ever-changing ensemble of different layers related to different epochs in which the new intervention will be inserted.
The White House, Bendheim Restoration Glass, Washington

[Concealed upgrade with Restoration Glass]

The intervention consist of the replacement of the historical windows of the White House with a restoration glass produced by the American company Bendheim and manufactured in Germany by Glashütte Lamberts, where “craftsmen hand-make each sheet utilizing centuries-old, authentic antique window glass making techniques.” (22)

In particular this glass defines an “authentic new window” which ensures the maintenance of the historical appearance of the building while improving its technical performance in terms of energy efficiency and comfort. As the producers themselves stated: “our glass is virtually indistinguishable from the original panes and must be documented to insure historical accuracy” while “the superior performance of Restoration Glass meets today’s stringent building codes”. (23)

This way of treating our cultural heritage emphasizes the nostalgic will to keep the appearance of the building as much as possible as it was, with a series of interventions for its upgrade which remain concealed both from the outside and from the inside.

In this respect, it is interesting to notice how this kind of strategy slightly evolved when in 2011 president Barack Obama wanted to instal a series of solar panels on the roof of the White House to make it also produce energy rather than only saving it.

This kind of intervention can still be considered as concealed - since it is not actually possible to see the panels unless you are on the roof - but it also emphasizes a view which does not consider unacceptable to juxtapose the new and old layers of the history of the building.
Castelvecchio Museum, Carlo Scarpa, Verona, Italy, 1957-64

[Juxtaposition of old and new]

Even if it is not possible to consider the intervention by Carlo Scarpa in the Castelvecchio Museum as a replacement project, the design emphasizes a very interesting manner to juxtapose the new and the old with the aim of creating a new ensemble which enriches the constantly evolving history of the building. It is possible to identify Scarpa’s position with his statement: “buildings that imitate look like humbugs and that’s just what they are.”

The castle has a very complex and rich history; it was built in 1354 with defensive purposes and it was subjected to a series of modifications especially in the 19th century with the Napoleonic invasion and in 1925 with an historicist reconstruction.

The present analysis will focus on the intervention made by Scarpa in the northern facade of the Courtyard, where he treated this facade as a theatrical stage, operating a series of strategic demolitions and tactical interventions to emphasize the different layers of its history. To achieve this he demolished the eastern part of the facade, destroying the solidity of the wall and making visible the series of different planes and layers characterizing the history of the construction. In this area, he also creates a very dramatic setting for the statue of Cangrande della Scala, the most renown piece of art in the museum.

Moreover, the architect added a series of windows to the openings of the facade, with the aim of creating comfort inside while outside the illusion of a second independent modern facade placed behind the existing one. In this way, the alien rhythms of old and new are juxtaposed, and the new is considered as another layer in the discontinuous history of the building. (24)

The value of this kind of intervention lies in its capability to “make history visible through the coexistence of fragments”. (25) In fact, the design is able to connect the new with the old without being afraid to hide their differences but with the aim of harvesting their intrinsic contradictions in the creation of a new powerful ensemble.
3.4 - ADDITION OUTSIDE

Description

The strategy consists in the addition of a new structure on the exterior of an existing building. It can vary from being a small intervention, like the addition of balconies or loggias, to the placement of a new external facade, until the addition of a whole new body that will constitute an extension of the existing building. In particular, in the case of the addition of a new external layer, the old facade will be no longer part of the building envelope and the new facade will be the one in charge of complying with requirements for improved environmental performance, with the space between the two layers acting as a thermal buffer zone.\(^{(26)}\)

In this respect, a particular case of addition outside concerns the creation of an additional exterior layer completely wrapping the building. Being the old complex completely wrapped by the new envelope, the technical demands for the original facade are reduced and the existing construction is upgraded from all outside thermal bridges. With this kinds of external interventions, the overall thermal resistance and energy efficiency of the ensemble is dramatically increased and the insufficient thermal performance of the old facade is no longer a problem. Moreover, the existing building is protected from atmospheric agents, avoiding wind, rains loads as well as the effect of pollutants.

In addition, the cavity between the new and the old layers can also be used for an elaborate ventilation concept, taking advantage of solar gains or thermal air movement.

The addition of a new body can be related to a strategy to also achieve the production of energy through a series of option which will be explored in the following pages. However, for the application of this strategy the load bearing capability of the existing structure has to be carefully considered.\(^{(27)}\)

Being this a strategy concentrated on an intervention on the outside of the building, the operation is likely to completely revolutionize the historical appearance of the existing complex. Therefore, a series of considerations regarding the way the new is going to interact with the old will constitute the backbone of the architecture of the new addition.

1. Addition of a new external facade in front of the building
2. Wrapping the existing in a new envelope
3. Addition of a new body to harvest and/or produce energy
Creation of a double-skin facade

One of the ways to achieve an improvement of the energy efficiency of existing buildings is by adding an exterior layer to create a double skin facade. This kind of facade is a system formed by an interior and an exterior surface, usually made by glass, which are separated by a ventilated air cavity. The void between the two layers creates a thermal buffer zone inside the facade which produces a microclimate capable of reducing heat losses in the winter and favouring ventilation in summer. In this way, the need to provide heating and cooling energy is reduced and, therefore, the system improves the overall efficiency of the building.

Moreover, the addition of an external layer is also capable of protecting the existing building from atmospheric agents and it will alleviate the responsibility of the existing facade in terms of its climatic performance.

The way of ventilating the cavity depends on the specific type of double skin facade and can range from natural convection caused by warm air naturally rising to the use of mechanical devices or to the application of a hybrid system combining the two. (28)

When adding an exterior layer to form a double skin facade within an existing building, a series of consideration has to be made to choose the correct type of installation. These considerations regard the tolerance of change of the existing material, load bearing structure and shape, as well as the type of climate characterising the site. In this respect, it is possible to state that because of their inherent thermal insulation properties, double skin facades perform better in cold and temperate climates, the kind of climate found in the Netherlands. (29)

In fact, during the winter the cavity provides an effective thermal barrier, whereas during the summer, ventilation of the cavity removes hot air and keeps the interior space cooler. On the other hand, if the system is used in hot and arid climates it will have to face problems of overheating and will then require a lot of mechanical ventilation that will challenge its actual energy efficiency. (30) In his Phd work “Re-face - refurbishment strategies for the technical improvement of office façades” Thiemo Ebbert identifies four types of double skin facades:

- Box window facades: This facade presents horizontal partitions at each floor levels, as well as vertical partitions between windows, which create a series of subdivided boxes on the facade. Each air cavity is typically ventilated naturally.

- Corridor facades: They are formed when the cavities are divided at each floor level, but do not present vertical divisions, so the horizontal air cavities are uninterrupted. There is not a main ventilation mode for the cavity in this kind of facade.

- Shaft box facades: it is the opposite of the corridor facade. It therefore presents vertical divisions and uninterrupted vertical air cavities. In this way the ventilation in the cavity is carried out with the natural stack effect of warmer air rising upwards. In this kind of facade, a hybrid ventilation type is usually applied.

- Multi-storey facades: they present uninterrupted air cavities the full height and width of the facade; they basically consist of a glass screen placed in front of the original building envelope. Also in this case there is not a prevailing ventilation mode.
External bodies to save and produce energy

- Addition of a greenhouse to harvest solar gains
  The addition of a new glassed volume that functions as a greenhouse is capable to provide the existing building with a new system capable of harvesting solar energy for the overall improvement of the energy efficiency of the building. Greenhouses exploit their capability to collect and absorb solar power throughout the day and release it to the internal space at night. Moreover, the heat collected during the summer can be also stored underground in a heat storage and then used in the winter.
  The functioning of the solution depend on the special orientation, shape and climate conditions of each situation. (31)

- Creation of a trombe wall
  It is another device to collect and absorb solar energy which will be then stored and used when heating is needed. In this case, the accumulation is carried out by a “high-density heat-accumulating” wall painted in black, placed behind a sun-facing glass surface with an air space separating the two.
  The “heat-accumulating” wall stores the heat gained from the sun during the day and releases it during the night. (32)

- Phase-change materials (PCM)
  A phase-change materials, is defined as “a substance with a high heat of fusion which, melting and solidifying at a certain temperature, is capable of storing and releasing large amounts of energy. Heat is absorbed or released when the material changes from solid to liquid and vice versa”. (33)

- Solar Ivy
  This device, designed by SMIT (Sustainably Minded Interactive Technology), consist of a system of thin “photovoltaic leaves” applied to the side of a building which are capable to produce energy by reacting to the power of the sun and also to the force of the wind. They are constructed by a layer of thin-film material on top of polyethylene with a piezoelectric generator attached to each leaf. (34)
Architectural characteristics

The question of the modification of the external appearance of the existing building is of crucial importance when considering the strategy of addition outside since an external addition is a kind of approach that irremediably changes the historical appearance of the considered building.

For this reason, if the priority is to preserve the external look of the complex - a fact due also to the application of the status of listed monument determining a series constraints on the changeability of the exterior - this kind of approach might not be the most suitable option. On the other hand, the approach does not involve any major operation in the interior of the building, so it can be the best solution if the priority is upgrading the historical construction while preserving its interior layout.

However, it is possible to appreciate the capability of this kinds of interventions to revitalize the historical look of the building by making it more contemporary, attractive and unique.

Moreover, this approach can also be used with historical buildings to protect the existing complex, enclosing delicate and fragile constructions in a protective layer.

In this respect, the most pressing issue will be, as it is always the case, to strike the right balance between old and new, to achieve a communication, an harmony or a contrast between the different layers of history capable to ultimately create a new beautiful ensemble. In particular, the ultimate effect of the relation between old and new will be determined by the way the architect will reflect upon a series of architectural themes - emphasized in the diagram - strictly connected with this kind of operation.

In conclusion, it is possible to state that in carrying out this kind of strategy, history will be considered as an ever changing ensemble of different layers in which the new intervention will be inserted and will constitute itself a new stratum in the biography of the historical building. The ultimate value of the intervention will therefore be related to the resulting effect of the ensemble of old and new, being it derived by the will to create harmony or a contrast between the two.
School for Fashion and Graphic Industry, Erick van Egeraat, Utrecht, Netherlands, 1997

[A new envelope creating a contrasting rhythm between old and new]

This school in Utrecht was remodelled with a new exterior glass layer determining a new cladding enclosing and protecting the existing building. In this way, the complex is upgraded from the thermal bridges and the heat losses characterising the old envelope.

The new external layer is constructed by glazed panels supported by aluminium mullions spaced at uneven intervals and positioned 150mm from the original building. This new facade acts as a screen, enclosing the building with its constant 12m height which remains the same even when the height of the different parts of the building changes. The new layer acts as a veil, protecting but at the same time revealing the presence of the historical building behind it.

Moreover, since the rhythm of the positioning of the aluminium mullions does not follow the one of the windows of the existing building, a contrast producing a dynamic tension is created between the two layers. Furthermore, another contrast is achieved in terms of the different textural qualities of the new glassed transparent and light surface and the historical facade.

When reflecting upon this intervention, it is possible to state, that the architectural possibilities derived by the addition of a new glassed screen enclosing and protecting the exiting historic building are fully exploited to achieve a new character based on the communion of past and future.

In fact, this new exterior layer creates a new image for the building, revitalising its existent appearance into a unique new ensemble of old and new.

As the architects describes: “by divorcing the facade from the structure and the internal arrangement of the building, the creative possibilities were endless. It can be anything from a free suspended membrane to a load bearing wall. It allows for an architecture in which the outline of the structure is unresolved. Is it a display case? Is it a quotation? Is it the unsentimental acceptance of the nature of the materials? The answer to all these questions is that it is both, or even better all of them.”
Prêt-à-Loger, Solar Decathlon Europe 2014, TU Delft team
[A body to harvest and produce energy upgrades the Dutch house]

The 2014 entry of the TU Delft faculty for the Solar Decathlon competition is characterised by the project denominated “House with a Skin”. The design is focused on an existing row of terraced houses in Delft dating from the 1960s and aims at upgrading the buildings to contemporary standards of comfort and energy efficiency by adding a new external body to the existing houses.

In particular, since the intervention is focused on the exterior, the cosiness, intimacy and character of interior of the traditional Dutch house are not changed, while the new skin plays an important role in revitalising the exterior image of the house, making a new powerful ensemble of old and new which is able to preserve history by actively intervening on it.

As described by the team in the entry of the project, the skin consists of a “cold side” facing north and a “warm side” facing south. On the cold side, an extra layer of insulation is added to diminish heat losses, whereas on the warm side a glassed greenhouse is created which is capable to harvest solar gains.

In this respect, the adaptability of the skin determines the behaviour of the structure according to the different periods of the year. In fact, during the winter the skin is closed to minimize heat losses, whereas in summer it is open to maximise natural ventilation and the PV cells placed on the top produce solar energy while ensuring shading and a pattern on the facade. (9)

Furthermore, the shape of the skin creates an extra space for the house on the outside, an “inside-outside” garden which can be used all the year and that creates a buffer zone which maximises the efficiency of the building.

In addition, the design employs the concept of “zone division”, grouping the spaces of the house into different categories according to their different power needs and ensuring the harvesting of heating and cooling based on the occupancy of each room. Moreover, the house is inserted in a urban plan focusing on a synergetic networking between the different units.

Even if the design is on a private house and not on a public building, it provides a very intersecting example of the architectural employment of strategies like the addition of an exterior body to harvest as well as to produce energy and the use of the zone division and networking concepts.
3.5 - COVERING

Description

The strategy consists in the covering of the building with a new roof construction which, by ensuring the creation of a new microclimate in the interior, would be capable of improving its thermal efficiency as well as protecting the historic construction from atmospheric agents and pollutants.

In fact, the climatic buffer zone created with the construction of the new roof will help reducing heat losses and harvesting solar gains; as in the case of double skin facades, this concept usually functions better in cold and temperate climate, such as in the Netherlands. In this case, the climatic buffer will be able to reduce the heat load of the building during the winter by harvesting solar gains and minimizing heat losses, whereas in the summer it would be easier to avoid the overheating of the covered area through natural ventilation than in hot and arid conditions. The overall energy efficiency of the intervention is dependent on the particular situation in terms of solar exposure and geometry of the building, which will ultimately influence the choice of spanning technique, shape and materialization. (39)

In terms of structure, usually the most efficient solution is to sustain the weight of the new construction with the structure of the existent building, if allowed by its load bearing capability; new columns can also be used to collect rain water. In addition, an efficient ventilation system has to be devised to avoid overheating problems during the summer and to allow exhaust air to exit the existent building, with a recirculation of fresh air.

The ideal way to do this is by natural ventilation but in some situations it is not enough and an hybrid or mechanical types of ventilation are required.

In terms of daylight, the use of a dynamic shading device is usually the most efficient option since it reduces light exposure in summer, thus avoiding overheating, while harvesting light in winter. In this case PV cells can provide shading as well as energy. However, it also has to be considered that the new roof will reduce the availability of daylight in the surrounding rooms, because of absorption by the glazing material and obstruction by the supporting structure.

Furthermore, the creation of a new roof can also create acoustics problems caused by the absorption and reverberation of the glass. (40)

Above: annual energy consumption of buildings in relation to their kinds of atria and ventilation techniques.
Materialization

- Glass
Since the Industrial Revolution, glass has been the predominant material for the spanning of big covered spaces. In particular, the use of glass panels supported by a cast-iron structure was the common feature characterising the new emerging building types of the 19th century. In fact, the covering of railway stations and the creation of urban passages and arcades assumed a very important role in characterising the powerful atmosphere of cities such as Paris or Milan. However, it is possible to state that the most famous, influential and admired glass and iron structure was basically a huge greenhouse, the Crystal Palace design by Joseph Paxton for the International Exhibition of 1851. (42)

When designing with glassed covered space a series of considerations has to be made to avoid a series of problems such as overheating, glaring, the absorption of light and the reverberation of sound, which were briefly examined in the introduction of this chapter.

- ETFE (Ethylene Tetrafluoroethylene)
ETFE consist of a fluorine based plastic, designed to have high corrosion resistance and strength over a wide temperature range. In fact, it has a very high melting temperature and an excellent chemical, electrical and high energy radiation resistance properties, which make it able to resist to the degradation caused by UV light and atmospheric pollution. (43)

Compared to glass, it has a series of advantages regarding its extremely low maintenance, recyclability and lightweight. A secondary structure is needed for the construction of an ETFE covering. (44)

- Integrated photovoltaics
Photovoltaics (PV) cells printed on the glass are devices that use solar power to generate electricity and heat.

There are two main types of facade-integrated PV modules.
Thin films solar cell modules: they consist of thin films of interconnected solar cells, which convert visible light into electricity, sandwiched between glass panes. They can be integrated in almost any facade surface, such as shading devices, spandrels and vision glass. (45)

Solid solar cells modules: they are usually integrated with spandrel areas or shading devices. (46)

The most common types of PV are microcrystalline silicon cells, polycrystalline silicon cells and amorphous silicon cells.

The performance and aesthetic appearance of PV cells depend on their type, their size and position relative to sun's path in terms of orientation and inclination. In the northern hemisphere the most efficient positioning is to orientate the panels towards the south with an inclination of 30 degrees.

In terms of their architectural potentialities, PV cells can be used to create an interesting pattern on the surface to which they are applied or they can also be able to generate an interesting play of shadows in the interior of the spanned space.

Moreover, as happens in Villa Flora, designed by Jon Kristinsson in Venlo, PV cells can be used in combination with solar collectors. These devices are able to improve the efficiency of the PV cells by optimizing the incidence of the solar radiation on the panels. Moreover, they also create a characteristic architectural image with their parabolic shape. (47)
Architectural characteristics

The strategy has great architectural potential derived from its capability to completely revitalize the space defined by the historic building creating a new synergy between old and new.

In fact, by spanning a courtyard and making it a covered space, an extra functional space is created and at the same time, the relation between the inside and the outside of the old building is completely redefined.

In particular, the approach gives the possibility to create something new within the boundaries of the old, to interpret the historical heritage by finding a way to enhance and reinforce its character by giving new attention and a different perspective to its forgotten qualities.

In this respect, when creating a new roof over an historical building, the position assumed by the architect will influence the way new and old are going to interact and the hierarchy they are going to establish. In fact, the old can be predominant, with the roof which attaches itself to the structure in the lightest way, whereas the new can dethrone the superiority of the old building with a daring and audacious architectural solution, or the new and old can work in symbiosis in a way that enhances the overall perception of the building.

[The protective canopy to revitalize the image of the museum]

The British Museum was built between 1823 and 1852 following the design of the English architect Robert Smirke (1870-1867). In his original plan the central courtyard was intended as an open public space for the citizens of London. However, soon after completion, the museum was extended and a round domed structure to use as reading room was placed in the middle of the courtyard.

After almost 150 years after its construction, the survival of the building was endangered by the degrade caused by the action of atmospheric agents and pollutants. Therefore, the firm Foster & Partners was appointed the task to protect the building with a new cover of the courtyard and to revitalize this powerful public space of the city. In particular, with the relocation of the British Library from the central reading room of the museum to the new building in Euston Road, there was an opportunity to redefine the space in the courtyard and making it part of the public realm again.

The design consist in a glazed canopy that encloses the courtyard in a new roof, protecting the historic building and creating a microclimate that will augment the energy efficiency of the structure by reducing heat losses and provide an harvesting of the solar thermal power in the winter.

The primary structure of the canopy is made by a steel framework and the weight of the new roof is sustained partly by the walls of the existent building and partly by new concrete columns. “The 3312 panels of glass are screenprinted with small dots on 50% of their surface with a technique called fritting.” This technique allows the glass to filter ultraviolet rays and therefore to reduce solar gains and overheating during summer. (88)

When reflecting upon the value this intervention, it is possible to state that the new cover is able to collaborate with the existing building and at the same time to redefine and revitalize it by creating a new atmosphere and a new iconic architectural image for the museum and for the city.

[A cover producing energy while creating a new atmosphere]

The market complex was built in 1868 following the design by Jean-Charles Alphand, a French engineer and urban planner working for the Baron Haussmann. It was scheduled for demolition in 1976 and, after being saved by a petition, it was listed in the French heritage in 1982 for its value as a representation of the “great tradition of metal-framed architecture that marked Paris at the end of the nineteenth century”. (49)

In 2007 a competition was held for its renovation; the winning design by Studio Milou focuses on a series of upgrading strategies - based on replacement and covering - used to improve the performance of the building as well as to emphasize a series of architectural themes such as transparency, lightness and contrast between old and new.

In this respect, a neat distinction is created between the existing steel frame structure of the historical building and the new intervention, characterised by the use of oak to define the new design and to create a contrast with the existing based on the tactile, textural and visual difference between this warm coloured material and the exiting steel. Oak panels are also placed on the roof, creating a double skin system with the interior layer of wood placed 45cm from the exterior metal structure.

In this way, the thermal and acoustic performance of the building is upgraded.

Moreover, new double-glazed windows are used to replaced the old ones on the roof and on the facades, and a new glass, steel and wood element is used to replace the original masonry walls enclosing the building, thus maximising transparency between inside and outside. The new double-glazed windows on the roof are characterised by the presence of solar panels on the south facing parts of the pitched cover. This elements, measuring 10x15cm, allow the building to produce energy while providing shading as well as an interesting pattern, being arranged like “over-sized pixels on the roofs, forming a design that becomes less and less dense towards the ridges. On the northern side, the same design is used, but made up of empty spaces forming a kind of anti-symmetrical arrangement that allows light to enter”. (56)
3.6 - NETWORKING

Description

“Don’t insulate like idiots, network well instead.” \(^{(3)}\) 
(Thomas Gautsch - Amstein and Walthert Engineering)

The strategy adopts the concept of synergetic urbanism, which considers buildings as working together rather than as separate entities. In particular, the energy that each building produces and accumulates is stored in an underground inter-seasonal heat and cold storage and then used in combination by the different buildings according to their present needs. The possibility that different buildings share heating, cooling and electricity depending on their present requirements, plays a major role in increasing the overall energy efficiency of the city system.

As explained by TU Delft professor Andy van den Dobbelsteen in his lecture “Introduction to Innovation and Sustainability”, there are four main modes in which this storage and distribution of energy can be carried out.

This types - illustrated in the picture - are: cascading grid, cascading machine, inter-exchanging machine and individual self-provision.

The simplest interpretation of the networking strategy is to consider its application at the level of the single building through a concept of zone division. This operation consists in grouping the spaces of the house into different categories according to their different power needs and ensuring the use of heating and cooling energy based on the occupancy and requirements of each one of them.

On the other hand, the full elaboration of the strategy will require the connection of more buildings to create a network between them. This will ensure the sharing of heating and cooling energy, through underground storage and water pipes connections, or the simultaneous use of the electricity produced by the buildings - for instance with PV cells - through wire grid connections.

The degree to measure the ultimate success of the strategy - both in the zone division and in the urban networking scenarios - is directly related to the programme of the buildings, since the particular function will have a great influence on their requirements in terms of energy consumption.
Seasonal thermal energy storage

The storage of energy and of heat and cold plays a very important role in the functioning of the networking strategy. This concept aims at storing the heat captured by the building during the daytime or during summer and the cold absorbed in the night or in winter and then use it when needed. The circulation of heat and cold is carried out through water. There are several ways in which energy can be stored for a long period of time.

In underground thermal energy storage system, for instance, the storage medium consists of geological strata with a different degree of permeability.

Other storage techniques include pit storages (shallow dug insulated pits filled with gravel and water), large-scale above ground water tank storages, or horizontal heat exchanger. (52)

The characteristic of Dutch soil as being formed by multiple different layers with different permeability suggests the use of an underground thermal energy storage system based on the use of aquifer.

An aquifer is a natural sand layer surrounded by watertight layers of clay, which make it the ideal place to store water underground. To build the storage system two aquifers are needed, an upper one for the hot water and a deeper one for the cold one. These two aquifers are then connected to the building with two systems of pipes, one for the hot and the other for the cold water.

During the summer, the cold stored from the previous winter will be extracted and will contribute to the cooling of the building, whereas in winter is, the warmth collected in the previous summer can be used to minimize the energy required for heating, after being brought to the desired temperature with an heat pump. (53)

This concept can be used by a single building or can form the backbone for a network of energy sharing that will interest the exchanging of heating and cooling and also of electricity of different buildings considered as an ensemble through the concept of synergetic urbanism.

In this respect, it will be interesting in the concept of the graduation project to explore the challenge derived by establishing a network of campus buildings and to harvest the possibility to create a system for the seasonal storage of energy in the context of the historical city centre of Amsterdam.
Villa Flora, Jón Kristinsson, Venlo, Netherlands, 2007-12

[Inter seasonal heat and cold storage in this manifesto for sustainability]

The complex successfully takes into account a great number of aspects of integrated sustainable design, managing the harvesting, production and storage of energy, a feature which earned it the denomination of “greenest building in the Netherlands” and made it a manifesto for sustainability. (54)

In particular, the design employs the concept of “zone division”, producing different climatic zones between the south facing tilted glassed greenhouse and the north facing five floors of office spaces. In this way, the amount of heat and cold provided to each area differs according to its requirements and the energy accumulated by each zone can be transferred to another one depending on its present needs.

Furthermore, a system for the production of energy is located on the roof where the parabolic solar collectors manage to provide hot water and electricity using solar energy, as well as cold water harvesting the condensation during the night.

In particular, the energy produced by these solar collectors and the one accumulated in the greenhouse are efficiently stored in an underground storage. This system takes advantage of the presence in the soil of an aquifers, consisting of a sand layer surrounded by watertight layers of clay, in which water is injected and extracted according to the seasonal needs of the building.

In fact, during the summer, the heat accumulated in the greenhouse is transferred to the upper aquifer, whereas the cold water stored in the previous winter is extracted from the deeper aquifer and used to cool the building. During winter, instead, the warm water collected in the summer is extracted from the upper aquifer, brought to the desired level of 30 degrees through a heat pump, and finally used to heat the building. (55)

The building constitutes a very interesting example of the employment of an efficient technique to store energy and to use it according to the needs characterising each season. In this respect, the character of the Dutch soil as being formed by various layers of different permeability, as well as the relative little invasiveness of the technique, suggests the possibility to use this strategy also when intervening on existing historical buildings.
Aquifer Thermal Energy Storage and Networking, Eindhoven Technical University

[Synergetic urbanism to harvest, store and distribute energy]

In the Eindhoven Technical University the concept of synergetic urbanism is fully exploited with the storage and networking of energy though an underground aquifer thermal energy storage. The system, one of the biggest installation of the type in Europe, is constituted by 24 warm and 24 cold wells, connected to a distribution network which supply heat and cold to the different campus buildings.

In particular, the heat accumulated during summer and the cold collected in winter is transferred from each building through water pipes - made of non-insulated Medium-density polyethylene (MDPE) - to an underground upper aquifer for the hot water and a deeper aquifer for the cold one. The system of water pipes connects the different buildings of the campus to the aquifer and creates a network through which each building can participate to the storage and the harvesting of heat and cold as well as sharing them with the other buildings of the university. (56)

In this way, the energy load for heating and cooling of the single buildings is considerably lowered because of the use of the storage system and in particular through the synergy established by the networking strategies which allows buildings that need more energy to take advantage of the surplus energy stored by other buildings with lower requirements.

“By storing heat and cold in the soil, the university annually saves some two million KWh on electricity and more than 300,000 m³ on gas.” (57)

The design is an interesting example of how much a university campus can benefit from the high degree of efficiency derived from the storage and networking of energy characterising the concept of synergetic urbanism.

In this respect, the UvA is also defining a future plan to provide the Science Park with a similar district heating and cooling system. (58)

In particular, it is of great interest for the graduation project to consider and explore the challenge to establish this kind of synergy between the various building characterizing the UvA cluster of humanities in the historical city centre of Amsterdam.
SITE SPECIFIC RESEARCH

Urban, architectural and technical analyses of the site and of the chosen building
4.1 - CITY AS A CAMPUS

Qualities and challenges

The brief of the graduation is an intervention in the context of the Binnengasthuisterrein, the area in which the core of the University of Amsterdam campus of humanities is situated. In this respect, it is possible to interpret the positioning of the university buildings of the area and of the surrounding city centre as creating the condition of a “city as a campus”, where the institutional buildings are integrated with the city and placed among other urban activities, rather than constituting an isolated enclave. This interesting condition of the UvA presents a series of intrinsic qualities which it could be possible to harvest in a design project, as well as a series of challenges that the intervention should be able to address. These qualities and challenges, therefore, will constitute the premises for the arguments that will be examined in the urban and architectural analyses in the following sections and for the basic considerations informing the design process.

In this respect, among the qualities that will be considered as consequences of this condition of city as a campus there is the possibility of creating a stronger university network in the city between all the buildings of the UvA, an institutional web arranged in the urban fabric. This situation would allow also to exploit the mix of functions in the area, so as to make the campus area more diverse and lively also when the university is closed.

On the other hand this feature of a university campus placed among other urban buildings creates a series of challenges such as the conflict which is created between the degree of privacy required by urban functions like housing and the public character intrinsic to an institution as the university. In this respect, a design intervention on the area should be able to address this issue by establishing, for instance, a balance between public and private and a degree of flexibility, connection and separation between them with the creation of semi-public and semi-private spaces capable of acting as “buffer zones”. Moreover, another challenge is derived by the difficulty of creating a “university feeling” when the buildings are scattered amongst the city. For this reason the creation of a stronger network between the university buildings will be capable of gradually expressing the presence of the university institution while maintaining an equilibrium with the other urban functions.
University of Amsterdam growth and development

The University of Amsterdam is constituted by four campuses:
1. Cluster of humanities in the historical city centre (6500 students)
2. Roeterseiland campus (19000 students)
3. Science Park, far from the city centre (5000 students)
4. Academic Medical Centre, at the edge of the city (3000 students)
The foundation of the university is associated with the inauguration of the “Athenaeum Illustre” in the Agnietenkapel in 1632. This relatively small institution became in 1877 the Municipal University of Amsterdam, granting the right to grant the highest degrees and starting its exponential development. (1)
The initial core from which this development started was constituted by the Agnietenkapel itself, which was mainly used as an auditorium for public lectures, and the Oudemanhuisport building, acquired by the UvA in 1880. From this moment on, the growth of the institution was exponential, with 900 students in the year 1900, 2500 in 1935, 6500 in 1950, 7500 in 1960, 16000 in 1970, 25000 in 2000 and about 30000 today.

In particular, the rapidity of this growth is one of the main causes which shaped the cluster of humanities in the city centre as a campus as a city. In fact, to meet the need of quickly finding new facilities for the increasing number of students, the UvA started renting buildings scattered around the city centre, ending up by buying them after a period of time. In this way, the university was not identified with a single building but it became formed by the terrain of the city itself, establishing an interesting relation between this institution for the production of knowledge and the surrounding urban context.

“Studying in Amsterdam meant acquiring a detailed knowledge of the street plan” (2)

Nowadays, this network is losing strength since some of the buildings are vacant and unused, some are going to be sold and others are undergoing renovation due to the need to upgrade them. Therefore, the graduation project, will be inserted in this city as a campus condition with the aim of enforcing and complementing this already existing network of buildings and to strengthen the relation between the university and the city.
The example of Maastricht

The University of Maastricht was founded in 1976 with seven faculties located in the “Zwingleput”, the historical city centre and hosting a number of 16000 students. The positioning of the faculties in the core of the historical city represents a very successful example of the application of the city as a campus concept. The university buildings are merged with the other functions of the city, establishing a direct connection with the residential, institutional and working aspects of city life. This interesting relationship between the city and the campus manages to create a very lively and attractive environment, providing a constant degree of activity to the campus area even when the university is closed.

Furthermore, another very interesting aspect of the city as a campus characterising the Maastricht University is its close relation to the history of the city. In fact, since the university was founded about 40 years ago it occupies a series of historical building, renovating and upgrading them to contemporary standards of comfort and energy efficiency to comply with the needs of a modern university. Moreover, also an array of new buildings was needed and designed - like the Lecture Hall by Jo Coenen - providing the opportunity to establish a relation between new and old constructions in the context of the historical city centre.

The concept of the city as a campus can be related to the investigations carried out by Oswald Mathias Ungers in the context of Berlin. In particular, in the project entitled “The City in the City – Berlin: A Green Archipelago”, Ungers, together with Rem Koolhaas and others examined the possibility to consider the city as a “polycentric urban landscape”, an urban archipelago of interconnected buildings and events enforcing and complementing each other, interpreting the historical city as an accumulation of various cultural layers. “Every part of the city hides a discovery, is designed as a unique location, it is an assembly of events, of pieces and fragments, conflicting, interacting, complementing and hence condensing the urban context.” (3)

These examples offer valuable reference points for the development of the graduation project in the context of the UvA city as a campus.
4.2 - HISTORICAL DEVELOPMENT

The site is characterized by a complex history of different layers - summarized in the following page - resulting in an ensemble of buildings having a heterogeneous character derived by the different ages and styles in which they were built. Therefore, it is possible to appreciate its quality as a document of different historical layers and as a representation of different cultures and times. For this reasons, these characteristics of the area ought to be considered as being one of the qualities that should be taken into account and harvested when thinking about a design intervention for this place.

The different “architectural styles” of the buildings:
- Gothic
- Neoclassicism
- Neorenaissance
- Eclecticism
- Amsterdam School
- 1980-2000
1544 - OVERVIEW

The first important function of the location was a religious one.

1389 - Founding of Oude Nonnen Monastery (St. Mariavelde ten Nyen Lichte)

1403 - Founding of Nieuwe Nonnen Monastery (St. Doinysius ter Leyen)

1470 - Agnietenkapel

1578 - Alteration, (transition from a Catholic towards a protestant city council) which annexes the religious buildings and a new purpose was found for the buildings as a hospital. The founding of the Onze Lieve Vrouwengasthuis and Sint Pietersgasthuis in the former monastery buildings, the first served only women and the second only for men.

1635 - the area is named Binnengasthuis

1663 - row of houses along the Turfmarkt

1693 - reinforcing the enclave character

1777 - first renewals of the area

1832: French domination
1860: start of modernisation planning

1879: developing of the medical complex

1897: it becomes Academic Hospital

1909: continuation of the hospital project

1943: little modification

1963: little modification

1973: Allard Pierson Museum occupies the Bank

1981: The University of Amsterdam moves in

4.3 - USE OF THE AREA

Harvest the different characters of the buildings

The concept of a city as a campus provides the area with a series of buildings having different function, character, organisation and layout which work together in shaping the site. In this respect, a direct consequence of the difference between the buildings functions is that the area is a diverse and lively place also at night, in summer or in the weekends, when the university is closed. Therefore, this mixture of functions is a quality that should be harvested, while managing, on the other hand, to find the right balance between the degree of privacy required by urban functions such as housing and the public character intrinsic to an institution like the university.

In this respect, the analysis of the area and the observations and visits carried out in the past weeks make it possible to interpret the functioning of the place in terms of what is already there and what is needed, informing the ways a future design could intervene to harvest its qualities and provide some sort of solution to its “problems”.

In particular, when observing the site, it is possible to notice that the mixture of functions that is present on the area constitutes a very interesting quality derived by the condition of “city as a campus”, as described in the previous sections. In fact, urban functions such as housing, the Allard Pierson Museum, the book shop in the covered passage and the playground with children playing right next to the university buildings, all constitute interesting qualities determined by the city as a campus concept, and they should be therefore harvested rather than negated in the design process.

On the other hand, when looking at the character of the open public spaces, it is also possible to notice how there is not yet a satisfactory relation between the degree of privacy needed by housing and the public character of the university. This condition is emphasized at best by the Social Housing complex and the square which it defines. In fact, the lack of definition of a gradual change between public and private with the creation of “buffer zones” with semi-public or semi-private character make this place a no man’s land, an unused and empty square in the middle of the campus. Therefore, it is possible to state that the challenge to create an harmonic relation between the private and the public in the “city as a campus” condition will be one of the main objectives that should be addressed by the design intervention.

Demography and pressure on the area

As a consequence of being located in the city centre of Amsterdam the area is subjected to a series of different “demographic pressures”. First of all the campus is host to about 6500 UvA students, and the number is destined to increase in the upcoming years since the university is expanding. Moreover, other sources of pressure are characterised by the presence of a high number of tourists on the edges of the site, and by all the people living and working in the area. The most direct result of this pressure is the lack of parking spots for bicycles, with a great number of bikes left on the street.
Left: the impact of bicycles on the site

Right: main functions on the area

Legend:
- University
- Museum
- Housing
- Mix-use

Scales:
- 40 m
- 80 m
- 200 m
4.4 - SPATIAL CHARACTERISTICS

One of the most interesting qualities of the area derives by its unique spatial configuration in relation to the rest of the city centre. However, the analysis of the place shows that the open spaces characterising the site could be improved, since now they could be defined “poor” in terms of architectural quality and are hardly used.

In particular, the square defined by the Social Housing complex is unused and problematic for the unresolved relationship between the privacy required by the building and the public character of the university.

Moreover, the gap left next to the Second Surgical Clinic offers a series of possibilities to reconsider that entrance to the campus which today is still unexploited and unsatisfactory in the way the heritage is treated, since it basically consist of a parking lot a and a wall with graffiti next to the historical building. Furthermore, it is possible to consider the so called “in-between spaces” defining the void amongst the buildings as also in need of an intervention since they could offer so much more to this area than being a simple place to park the bike and passing through as they are at the moment.

For these reasons, the buildings emphasised in the plan will constitute the focus of the design project since they offer a series of interesting possibilities to influence the open squares, the internal courtyards and the “in-between spaces” which they define, with important consequences for the improvement and the functioning of the all site.
4.5 - ROUTING AND MOVEMENT

The surrounding of the area is well served by public transport, medium speed car routing and water transportation in the adjacent canals. On the other hand, inside the campus area the speed of movement is slower. In fact, the access is not allowed to cars and the inner routes of the campus are the reign of pedestrians and cyclists.

Moreover, this difference in the speed of movement between inside and outside is emphasized by the fact that the buildings defining the edges of the area act as borders, making the place more introvert and quiet than the rest of the city centre.

The particular spatial configuration and the special quality of the Binnengasthuis area are characterised by the buildings defining its surroundings, which enclose with a beautiful system of historic gates the inner part of the site in a series of open spaces and courtyards which are more quiet and introvert from the rest of the city.

In this respect, another challenge to be addressed in the design phase would be to harvest this special feature of the site by creating good public spaces but at the same time without creating a completely closed enclave, so as not to compromise the condition of “city as a campus”.
4.6 - CLIMATIC CHARACTERISTICS

When focusing on the upgrade of the existing is of great importance to study the climatic conditions of the area to understand the characteristics of the buildings in terms on their exposition to sun, hot and cold, light and shadow, humidity and precipitation, wind and ventilation.

In this respect, Amsterdam is characterised by a temperate coastal climate, which is “moderately warm, humid, rainy and changeable”; the proximity to the sea makes it windy, with frequent precipitations, short, cool summers and mild winters. The predominant wind direction is south-west. (4)

In this kind of climate, buildings have to protected mostly against humidity and wind.

Sun exposure at 12 a.m. depending on the seasons

Spring | Summer | Autumn | Winter
4.7 - ENERGY EFFICIENCY IN DUTCH UNIVERSITIES

As explained by Alexandra den Heijer in her dissertation “Managing the university campus”, Dutch universities are subjected to a series of threats regarding their weaknesses in terms of energy efficiency. In particular, these menaces are derived by the age of the campus buildings and their consequent technical problems, as well as from their elevated energy cost and consequent high ecological footprint, which is destined to increase in the future for the constantly rising number of students.\(^6\)

In this respect, a series of agreements has been stipulated between Dutch universities to improve their energy efficiency. In particular, these institutions have agreed to the goal of achieving a 30% reduction of energy consumption in the period between 2005 and 2020 and of 50% before 2030.

During 2008 the so called “Third long term agreement” has become effective for the fourteen Dutch universities which signed it.\(^6\)

The common operations between Dutch universities directly related to this agreement concern the will to “green the campus” by supporting environmental goals derived by the improvement of the energy efficiency of the buildings, as well as by creating a more environmentally conscious knowledge in the users and also by optimizing the use of energy with the establishment of more support for facilities sharing and synergy.\(^7\)

The University of Amsterdam is part of the group of institutions taking part in this agreement. This resulted in the establishment of a energy management programme regarding the UvA which is concerned on energy efficiency planning, monitoring and energy management.\(^8\)

The UvA, founded in 1632, has an overall number of about 30000 students distributed in 7 faculties - Social and Behavioural Science, Humanities, Science, Economics, Law, Medicine, Dentistry and Liberal Arts - and located in 4 campuses: City Center Binnenstads campus, Science Park, Roetersel and the Amsterdam Medical Center.

In terms of the measures already taken regarding the improvement of the energy efficiency of the institution, it is possible to notice a disparity when considering each campus differently. In fact, the Roetersel campus seems the most advanced, since a series of measures to reduce energy consumption and also to produce energy have already been undertaken.

These operations concern the installation of thermal energy storage systems underground capable of providing both heat and air conditioning; in fact, excess warmth is stored in the ground during summer, and can then be used to heat buildings in winter, whereas the cold stored during winter can be used to cool the building during the summer months. Moreover, other measures regard the use of energy-efficient lighting and heating systems, the installation of CO\textsubscript{2} controlled ventilation systems and of thermal facades and also the use of solar panels for energy production.\(^9\)

On the other hand, these sustainability measures are not currently being used in the historical buildings of the city centre campus, where their listed status as well as their cultural and historical features make the undertaking of these operations more difficult. In this respect, the graduation project will be following the intentions of the UvA to be more sustainable and energy efficient while challenging the architectural and technical difficulties arising from the application of strategies for building upgrade in the context of the historical city characterising the Binnenstads campus.
4.8 - FUTURE PLANS

Amsterdam: De Rode Loper

The project focuses on the refurbishment of the public space on the Route from Damrak-Rokin-Muntplein-Vijzelstraat en Vijzelgracht, with the following goals: preserve the current accessibility and traffic flow, improve traffic safety, create more space for pedestrians, improve the quality of air, apply sustainable materials, prove a city access route with character and empower the historic structures. Therefore, it is possible to consider the plan as capable of empowering the role of the Binnengasthuis area in the dynamics of the city. Moreover, since the project aims at promoting the improvement of air quality and the use of sustainable materials, it is directly related to the challenge explored in the present research to upgrade the historic buildings of the “campus as a city” to modern standards of comfort and energy efficiency.

University of Amsterdam: new campus library

The project aims at moving the university library in the Second Surgical Clinic and the Zusterhuis, creating study spaces and a new covered atrium with a daring architectural intervention. Moreover, a very “contemporary looking” addition to the building will be created to fill the current gap facing Nieuw Doelenstraat, and a new underground parking space will be created to solve the problem of bike overcrowding in the campus area.

When analysing this project, it is possible to affirm that the idea to assign to these historical buildings the function of library stresses their tolerance of change with a very complex and demanding programme and proposes an architectural design emphasizing a strong contrast between old and new. Therefore, this design will be challenged and an alternative approach for intervening on the building will be proposed during the graduation project.
4.9 - ANALYSIS OF THE CHOSEN BUILDING

The New Clinic and Mensa: biography

In 1877, the Municipal University of Amsterdam was officially established, and the Binnengasthuis area was designated as an educational site for medicine. Therefore, to accommodate the needs of the new academic hospital complex, a new academic clinic was to be built on the site.

For this reason, the old men’s and women’s hospital which was on the area was demolished and in its place the New Clinic complex was constructed. (12)

The building was designed by Hendrik Leguyt (1840-1907), an assistant city architect at Dienst der Publieke Werken Amsterdam from 1873 till 1905 and head of the Department of Buildings from 1895. The important roles he occupied for the municipality allowed him to contribute to a large number of the five hundred projects completed between 1873 and 1890, and many others in the following years, making him a very important figure in the shaping of the character of the city of Amsterdam.

The New Clinic was finished in 1889 in an architectural language that is possible to consider as following the Dutch interpretation of the neo-renaissance style. In fact, the plan of the building presents a symmetrical structure and the facade shows a characteristic pattern created with the use of different kinds of brick.

The reason behind the design of the building with two separate wings is related to the need to have separate facilities for men and women.

After the academic hospital complex moved to AMC in 1983, the University of Amsterdam established its campus facilities for the cluster of humanities in the city centre, occupying the building with the Faculty of Sociology and Behavioural Sciences.

In 1991, the construction of the Atrium, accommodating the mensa and study spaces, was completed following the design of Paul Dirks, architect of the office Abma+Dirks+Partners. The aim of the design was to construct an addition in the central courtyard constituted by a “pyramid made of milky glass with inside steel connecting rods providing a unique spatial sensation” (13).

However, the atrium building today presents a series of architectural and technical problems - analysed in the following sections - which suggest to consider during the graduation project its demolition and its replacement with a different kind of space for the historical New Clinic complex.
**Architectural characteristics**

The historical building consists of an U-shaped volume creating two separate wings and its character is defined by the beautiful neo-renaissance brick facade and windows. The layout of the building emphasizes the symmetry and the equilibrium of the historic structure and the interior spaces are characterized by uninterrupted rooms with load bearing walls alternated with circulation cores hosting the staircases.

The new insertion in the courtyard completely redefines the relationship between inside and outside by creating new covered spaces for mensa and study facilities, and inserting a new atmosphere in the old building.

In addition, also the original distribution and circulation routes are modified, with the atrium becoming the new core of the building and expressing its characteristic as a public space within the dynamics of the university campus.

However, the quality and the value of the new atrium within the fabric of the old building will be questioned and challenged throughout the graduation project considering from the technical point of view the problems of insulation, acoustics, lighting and thermal resistance derived by its roof, and from the architectural point of view the lack of harmony and balance between new and old produced by this new insertion. For this reason, the design will consider the demolition of this new atrium and its replacement with a different kind of structure capable to participate also in the upgrade of the historical building of the New Clinic.
Left: plan of the building at its present state
Above: North-South section of the former hospital building
Below: West-East section of the former hospital building
Academic hospital building

- Structure: load bearing walls of brick
- Foundation: timber poles and foundation walls made of brick
- Floor construction: masonry
- Roof construction: timber structure
- Windows: single pane glass
- Insulation: mass of the brick walls
- Materialization: brick of different colours create a pattern on the facade

- Upgrade: judging by observation the upgrade operations already carried out on the historical building complex consist of the replacement of some of the bricks in the facade and some of the windows, as well as the positioning of new installations for heating, lighting and ventilation purposes.
New additions: the mensa and the atrium

- Structure: reinforced concrete load bearing columns
- Foundation: reinforced concrete foundation system
- Floor construction: reinforced concrete
- Roof construction: steel and glass
- Windows: single pane glass
- Insulation: none
- Materialization: the steel and glass construction on the pyramid shape of the mensa and on the pitched roof in the atrium creates transparency, but the concrete volumes forming the study spaces render the incidence of natural light insufficient.

- Problems of the atrium addition which suggest to proceed with demolition: as UvA representative Davy Demmers explained in a lecture the tilted roof has a series of problems derived by the fact that it is leaking and therefore an intervention will be needed to improve its construction. Moreover, judging by the observation of the building, the space in the atrium presents problems of lighting, since the little incidence on natural light demands the use of artificial light also during daytime. Moreover, the sound is reflected by the glass panels on the roof, creating acoustics problems in the interior space. In addition, the lacking of insulation in the construction causes a series of problems related to heat loss in winter and overheating in summer.
Value assessment

- Expert value: listed monument for its qualities expressing the character of Dutch neo-renaissance as well as the layout of old hospital buildings.

- Community value: intangible value of the academic hospital as a testimony of past experiences as well as knowledge production and sharing.

- Design value: historical document of the design of Hendrik Leguyt for the academic hospital.

- Age value: building layout with different wings to separate men and women. Central courtyard, big windows and high ceilings to allow the maximum of fresh air to the patients of the hospital.

- Object value: beauty of the historical neo-renaissance buildings and inadequacy of the new atrium addition.

- Context value: qualities of the Binnengasthuis area as a special place in the city centre, as examined previously in the urban analysis.

- Not a value: atrium addition and interior modifications
4.10 - POSSIBLE APPLICATIONS OF THE STRATEGIES

Addition inside

As examined during the technical analysis of the buildings, it is assumed that both the New Clinic, since it was constructed in the 19th century, presents an envelope made of load bearing walls of brick, where the insulation role is carried out by the mass of the walls itself.

In this respect, it is possible to consider the addition of an internal layer of insulation as an important operation in the upgrade of the two complex to contemporary standards of comfort and energy efficiency.

In fact, the addition of an internal layer of insulation would be capable of reducing heat losses and thermal bridges as well as guaranteeing the preservation of the external appearance of the building.

However, when carrying out this operation, special attention has to be taken to avoid the formation of condensation and moulding, in particular on the edges of window frames. The addition of an internal layer of insulation will change the appearance and proportions of the interior walls and its thickness will be a consequence of the type of technique and material chosen.

In particular, the use of vacuum insulation panels and aerogels will allow for an extremely thin layer in comparison to more common insulation materials, but the fact that they are very expensive questions their ultimate sustainability.

On the other hand, it is possible to consider the use of a system of dynamic or switchable insulation as being hardly applicable to this kind of building.

Furthermore, another technique that could be used is to add a new facade - insulated or non-insulated - on the inside of the building to upgrade the complex from all thermal bridges and minimize heat losses. In this case, the operation will revolutionize the interior layout and appearance of the building and special attention would thus have to be taken in considering the relation which will be established between old and new in terms of their relative materials, structures, weights, rhythms and aesthetics. Also this operation will be able to allow for the preservation of the external appearance of the building.
Replacement

The New Clinic complex presents a window system made of single glass panes, which are not acceptable anymore in terms of contemporary standards of comfort and energy efficiency. Therefore, to ensure an upgrade of the building a replacement of these elements should be carried out.

In this respect, a choice is to be made regarding the way the windows will be replaced and a position has to be assumed on how the new is going to interact with the old. In particular, it is interesting to notice that some of the windows on the historical facade have already been replaced.

In the case of the replacement of windows, one of the options is the use of restoration glass. In fact, since the building is a listed monument, it could be considered a priority to preserve as much as possible the appearance of its original facades. Therefore, the use of a window system that mimics the historical windows would be considered an appropriate operation for its ability to conceal the upgrade and to maintain intact the historical character of the buildings.

On the other hand, another possibility is to upgrade the window with more advanced technology systems. In this case, the use of double and triple glazing or of vacuum insulation glass will allow to reduce to a minimum heat losses, whereas the application of photochromic glass, therмотropic glass, electrochromic glass or liquid crystals glass will be able to ensure a maximum harvest of solar light as well as a dynamic protection from it when needed. Moreover, the use of a self-cleaning glass technology would improve efficiency by reducing the need for maintenance.

In this respect, a series of questions, possibilities and challenges will arise on the way this new technologies could be able to establish a satisfying relationship with the historical building. In fact, by placing a contemporary looking window on the facades of this existing structure its historical character will irremediably be altered and therefore a position has to be taken on the way the new will interact with the old in terms of establishing a neat contrast of to find some sort of harmony with the historical layer.

Other options of replacement could be focused on other facade elements such as the brick walls or the tilted roof. However, these operations are extremely invasive on the historical appearance and structure of the existing
Addition outside

The application of an external layer wrapping the building and enclosing the historical facade in a protective envelope will be able to ensure a consistent improvement of the energy efficiency of the building by eliminating thermal bridges and minimizing the heat losses characterising the existing structure. However, when adding a new external facade, the historical appearance of the building will be irremediably altered.

Thus, if the priority is to preserve the external historical character of the building this strategy is of course not appropriate. On the other hand, the new addition could be considered as a screen protecting and revitalising the historical image of the building and therefore this operation appears as a suitable solution when the choice is to change and redefine the look of the existing construction. In this respect, in the case of the creation of a new external envelope a series of questions and challenges would arise regarding the load bearing capability of the existent structure as well as the way the new materials are going to interact with the historical architectural language of the existing construction.

Furthermore, another way to apply the addition outside strategy to the considered building - after the demolition of the present mensa and atrium building - will be to design a new external body in the space defined by the courtyard for the harvesting of solar power and/or for the production of energy.

In this cases, a series of considerations regarding the space available in the courtyard and the sun incidence on the new constructions have to be considered.

These operation will irremediably alter the character of the historical building ensemble and therefore a position has to be taken during the design process on the way the new is going to interact with the old in terms of creating a neat contrast between the two or to find a more delicate balance and harmony.
Covering

It is possible to consider the creation of a new covered atrium in the courtyard of the building as a very interesting option for the ability intrinsic to the operation of improving the energy efficiency of the complex as well as to create a new atmosphere related to the way new and old would interact.

In particular, when considering an intervention on the New Clinic, the option to demolish the existing Atrium seems appropriate since it is not functioning for a series of reasons explained previously in the analysis of the building. Moreover, the regularity of the geometry of the historical building does not involve any major difficulties in the covering of the space, even if the load bearing capability of the existing structure has to be checked if the aim to transfer to it part of the weight of the new cover.

In addition, the favourable sun exposition of the building allows for a solution capable to harvest solar gains as well as to produce solar power from the placement of PV cells on the roof. Moreover, it would be possible to harvest the capability of PV cells to create a shading pattern on the inside to influence the atmosphere of the new covered courtyard.

In terms of the materialization of the new, the choice between glass and ETFE for the covering surface and between concrete, steel and wood for the supporting structure will be a direct consequence of the position that will be taken in the design process concerning the way the new intervention would relate to the existing.
Networking

The possibility of buildings working in a synergetic way to share heating and cooling energy, as well as electricity, represents a very interesting option in terms of the upgrade of the area to future standards of energy efficiency. In this respect, it is possible to individuate three main lines of action.

The first option would be to consider the New Clinic as a single entity and conceive a separate programme of energy sharing between the different zones of each building. So, for example, the energy produced by the solar incidence of the sun on the glazed courtyard of the new spanned atrium can be transferred to the other parts of the building or stored underground with an inter-seasonal storage.

The second possibility would be to make the New Clinic work together with the Second Surgical Clinic building, allow them to share the energy they gain and store when they require it.

Finally, a third and more ambitious option would be to create a new network of energy sharing and production considering the campus institution as a whole, by connecting the building of the university between them and possibly also with the other buildings of the surrounding urban fabric, and make them work together in a synergetic way.

The choice between these options will be executed during the design process taking into account two fundamental parameters that will influence the actual ultimate energy efficiency and functioning of the complex.

The first factor is determined by the programme that will be assigned to the New Clinic during the design phase. In fact, hypothetical future functions such as university building, library or student housing are related to different levels and kinds of energy consumption.

Furthermore, the second parameter determining the choice will be characterised by the tolerance for change of the historical city soil in terms of allowing the construction of an underground storage and of a network capable of connecting the various buildings.
RESEARCH ON THE NEW PROGRAMME

The library of the future
5.1 - CONTEXT

Complement and enforce the existing “network of knowledge” in the city centre

The conclusions drawn after the analysis of the site suggest to place a high degree of attention on the condition of campus as a city which characterises the University of Amsterdam cluster of humanities in the city centre. In this respect, the graduation project will pursue the goal of enforcing and complementing this already existing network of university facilities. By analysing statistics concerning the growth of universities, it is possible to notice how the constantly augmenting number of students determines an increasing need for more study facilities in the campus area.

Therefore, the project will suggest the creation of a new library in the New Clinic building, a place which will assume the role of a new meeting hub for students as well as for the surrounding community. The building will take advantage of his position in the Binnengasthuis in the city centre of Amsterdam, where all the other functions of the university will be at a walking and cycling distance and where an efficient network of public transport will also be capable to ensure connections on a bigger scale.

The new function will operate at the scale of the city, being inserted in the already existing ensemble of libraries and study spaces of the university.

In particular, the aim of the project will not be to create a new central library and substitute the already existing university library in Spui, but to complement and reinforce this already existing network of facilities with the creation of a new member with a special character capable of adding new value to the group of buildings dedicated to knowledge.

In particular, the new library will complement the existing network by providing something that the other existing libraries are not offering yet. In fact, the aim of the programme will be the design of a library for the future, a new interpretation of this secular function related to the changing characteristics of contemporary society. The building will not only be a library but a meeting point, a public living room in the context of the Binnengasthuis area, a place for public interaction as well as for a more secluded and quiet kind of study.

In this respect, the social relevance of the programme is related to the will of creating a network for the production and the sharing of knowledge in a contemporary society challenged by the economic crisis, placing the value of knowledge and debate at the centre of university and city life.
5.2 - WHAT IS A LIBRARY?

Value as a hub for knowledge production and exchange

The first definition of library given in the Free Online Dictionary qualifies it as “a place in which literary and artistic materials, such as books, periodicals, newspapers, pamphlets, prints, records, and tapes, are kept for reading, reference, or lending.” (1)

It also defines the more modern notion of a multimedia library, identifying it as “a public institution functioning as a library but containing not only traditional books, newspapers and magazines, but also video recordings (movies, documentaries), sound recordings (music, audio books) and all sorts of electronic resources”. (2)

However, it is possible to state that these functions represent much more than a space for storing and displaying information but a real core for the sharing and the production of knowledge which occupies a central role in the dynamics of the city. The library is a place where people “create, learn, discover and share”, a platform constituting the realm of debate as well as a place where people relax and spend their free time.

Most of all, the library is a “symbol of the power and potential of citizens, and it is still a location where people come together and cultural identity is created”. (3)

The notions of culture and identity play a very important role especially in the conceptions of library expressed in literature. In fact, for instance, Umberto Eco considers the library as a “model for culture”, whereas Jorge Luis Borges in “The Library of Babel” goes even further, identifying it as “the model of the Universe”.

In this respect, it is possible to acknowledge the value of the institution as forming a point of reference based on the importance of knowledge sharing, production and debate in a society where other values which shaped our life in the past - such as religion - are losing their predominant role.

On the other hand, the way people study is changing due to digitalization, so the library is no longer the place to consult books but also to use digital material and plug-in your computer. Moreover, digitalization is modifying also the way in which the future university will function, with lecture that can be recorder and seen without needing to be physically present within the boundaries of the institution. However, it is possible to state that there will always be a need for a place to meet, discuss and share knowledge, a location capable of characterising the identity of the institution of the university as well as of the community of students and the people inhabiting the surrounding places of the area.

“Finding the information to answer any question, books to satisfy the never-ending desire for pleasure, learning and knowledge, and the practice of literacy as one of life’s basic skills, will remain at the heart of what makes a library, and what will place the library at the heart of the community.” (4)

“As places for the collection of information, libraries are among the oldest types of buildings. In all ages they have had to take account of five main factors: the form of the media to be stored; the nature of their use; continuously increasing stocks; artistic and architectural changes of style; and, in conjunction with all these aspects, ongoing technological development.” (5)
The library of the future

What is a place to study, meet and share knowledge in today’s society? How will the function of library transform in the future?

The study “Envisioning the library of the future”, carried out by the British Art Council in 2013 and the collection of essays “The library of the future”, published in 2010, provided a series of interesting information to the present research.

In particular, it is expressed in both works how the condition and the character of the function of library are changing due to new trends emerging in today’s society. In fact, it is possible to state that the digitalization of books and the possibility to access information everywhere through the internet, is diminishing the role of the library as the centre and reference point for knowledge sharing and production. Moreover, the problems of funding due to the unstable economic condition caused by the crisis is constituting new challenges for the survival of the institution.

However, it is also possible to argue that even if the freedom in the access of knowledge allows people not to be tied to a fixed location anymore, there will always be the need for a place to meet, a place transmitting a sense of being together, where it is possible to gather, discuss and feel as a part of the community, an institution capable of representing the role of culture and knowledge and to shape the identity of the public realm.

On the other hand, to continue to maintain this important role in the dynamics of the city, it is important that the function and the character of the library will change according to the needs of today’s society. In particular, the future public library will be both a physical and a virtual place, somewhere people visit and somewhere to be part of wherever they are.

“The contemporary public library no longer merely houses and catalogues books and records; it also provides public access to the internet, computer workstations, recreation facilities such as café/restaurant, exhibition spaces, educational programs and even day-care facilities. In many ways, the library has become an appendage of the public space. An institute that houses multifaceted and varied programs under the same roof.”

The ideas emerging from these reflections and the will to insert the new library designed in the graduation project within the already existing system of libraries of the university and the city, suggest to provide the new library with something which will define it as a “library of the future” as well as a place offering something that the other libraries are not providing yet.

In particular, the concept which will be taken in consideration during the design phase will be to design a “library without books”, a building for the collection, display and use of multimedia material as well as for the production and sharing of knowledge derived by its positioning within the university and its capability to offer space for learning, meeting and debating.
The heterogeneous character of the library through time

- **2600 BC**
  - Early library
  - Clay tablets storage

- **300 BC**
  - Classical period
  - Papyrus library

- **476 AD**
  - Demise of Roman Empire

- **Middle Ages**
  - Monastic library
  - Amanuensis

- **21st century**
  - Internet
  - Bookless library

- **19th-20th centuries**
  - Administration, storage, reading

- **Enlightenment**
  - Total work of art
  - Book production

- **Renaissance**
  - Humanism
  - Academy

**Crisis of culture**

Only 1% could read
Place where knowledge is stored, ordered, preserved and passed on

Extension of the public realm Symbol of knowledge and culture

A signifier of public identity

Bibliothèkè: book (biblion) and storage (thèkè)

“Books are the carriers of civilisation. Without books, history is silent” (Voltaire)

Library as a network Multifaceted public space

Egalitarian agent to ensure the existence of knowledge and communication
### CASE STUDIES: the architectural themes of the library programme examined through archetypical examples

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Public Library, Gunnar Asplund, Stockholm, Sweden, 1920-1928, 9000 m²

[A central public space with more intimate lateral wings]

The typology of the building is characterised by a central lending area surrounded by lateral wings hosting a series of reading rooms. At the centre stands the core of the building, characterised by the central rotunda with books displayed on all the length of its walls. This core forms the most public and symbolic part of the building, being the main space for collecting books, meeting and debating. On the other hand, the lateral wings offer more silent and secluded reading spaces, with tables and furniture creating a relatively quiet study environment.

FACILITIES
Rotunda: book exposition and lending
Lateral wings: reading room, multimedia, children’s library, international library, music library, shops and storage on the ground floor.
Phillips Exeter Academy Library, Louis Kahn, New Hampshire, USA, 1965-72, 8404 m²

[Study spaces around a symbolic and monumental core]

The complex is organised around a central void, a light well providing the spaces around it with natural light. This is the most representational space of the building and its language, consisting of a circle inscribed in a square mineralized in concrete, has become the most symbolic part of the library.

The study spaces are placed around this heart and are defined by the wooden furniture designed by the architect, which gave a special attention on providing a series of desks and seating types capable of ensuring both a secluded and silent kind of study, as well as a more interactive and public way of working. Among this array of furniture there are 210 specially designed study carrels for students and approximately 450 different seating types.

“No longer a mere depository of books and magazines, the modern library becomes a laboratory for research and experimentation, a quiet retreat for study, reading and reflection, the intellectual centre of the community”. (7)

FACILITIES
Book stacks and reading spaces;
Student computer lab;
Viewing area for videotapes and DVDs and listening areas for music;
Offices for use of faculty members;
Lounge and terrace.
Central Library, OMA, Seattle, USA, 1999-2004, 38300 m²

[A collection of spaces with different programmes and atmospheres]

“The Seattle Central Library redefines the library as an institution no longer exclusively dedicated to the book, but as an information store where all potent forms of media, new and old, are presented equally and legibly.” (8)

Therefore, the programme of the library is interpreted with the will to create an important public space centred around knowledge. The design team criticizes the trend to interpret the notion of flexibility in the library as a collection of generic spaces producing ambiguous floors in which anything can happen, arguing that “the problem of traditional library organization is flatness”. Therefore, the project organizes the library into different areas, each used for a specific function and designed to specifically meet the architectural needs of each programme.

The organisation of the complex and diverse functions is characterised by their division into two clusters, one group identifying the “stable” programmes, whereas the other the “unstable” ones. The books are organised in a continuous ribbon denominated “Book Spiral”.

FACILITIES:
Stable functions: parking, staff, meeting, Book Spiral, headquarters.
Unstable functions: kids, living room, Mixing Chamber, reading room.
Sendai Mediathèque, Toyo Ito, Tokyo, 1998-2001, 21682 m²

[Flexibility and openness to allow the merging of different functions]

As stated by Toyo Ito, “enjoying paintings and books through electronic media will demolish the once established, archetypal, form of the museum and the library. They will all be fused into a single, seamless architectural type, and there will be no boundaries between the museum, the art gallery, or the theatre. They will all be reconstructed in a new form, the Mediathèque, which will be like a convenience store for the media, in which all forms of media are arranged together.”

This interpretation of the library suggested in this intervention to design a series of plans which are characterised by the maximum flexibility, allowing for the development of any type of function on each floor. Therefore, the mediatheque is designed as a multifunctional building, with openness, flexibility and transparency as its fundamental features. Each of the seven levels is constituted by a 50 × 50 meters platform cut by a series of pillars. These steel structures host a series of services - such as stairs, elevators and lifts for goods - to ensure the vertical physical and visual connection between the different floors.

FACILITIES:
- Level 0: reception, café, bookstore, delivery entrance, storage;
- Level 1: multimedia library (internet, tapes and DVD), current newspapers and magazines, children’s library, offices, meeting rooms;
- Level 2 + mezzanine: library, reading rooms and library office;
- Levels 4+5: exhibition galleries;
- Level 6: cinema, studio spaces, meeting rooms.
Public library, Mecanoo, Birmingham, UK, 2010-13, 35000 m²

[Vertical voids to provide connections and identity]

The building is Europe’s largest public library and was designed as a “People’s Palace”, a “centre for learning, information and culture that unites people of all ages and backgrounds” which emphasize the central role of the library in contemporary society. As stated by Francine Houben: “libraries at this moment are the most important public buildings, like cathedrals were many years ago”. (10)

The floor plans are characterised by a series of rotundas connecting the different levels. These powerful elements form the central heart of the complex and allow the movement of people and the passing of natural light as well as ventilation.

The skin, consisting of a glass facade with an exterior layer of steel interlocking circles - inspired by the local industrial tradition - has a great influence on the way the light is transmitted in the inside.

FACILITIES:
Sunken amphitheatre and auditorium, rooftop gardens;
Three main reading rooms, music library, multimedia and study centre;
Community health centre, Shakespeare Memorial Room and exhibition hall;
Archives, storage and offices. Cafes and lounge spaces.
The intervention is located in the courtyard of a former laboratory building constructed in 1908. The library is inserted in this central courtyard while the surrounding wings are left unchanged. The design consists of six elliptical rings stacked on top of each other and defining the space of the library, treated as a light piece of furniture inserted in the existing complex. The elliptical rings - characterised by wood finishing and supported by steel columns - form a series of galleries hosting the spaces of the programme. In particular, the parapets of the rings define a series of individual reading stations - creating a number of about 500 seats on all levels - whereas the book stacks at the back of the rings define the space of the walkway and divide the new library space from the existing building. The contact with natural light assumes a very important role in the construction, with the glass-covered dome on top dominating the central void space. Moreover, further light wells are created behind the bookshelves to provide also the interior of the old building with natural light.

The principle of a library as furniture is emphasized by the following description of the architect: “The library floats in the courtyard as if it were an enormous piece of furniture. The library as furniture; this idea was already there in the Renaissance and Baroque. Think of the Medicean Laurenzana in Florence or the Stiftsbibliothek in St. Gallen [...] I have attempted to make something contemporary which corresponds with this historical fabric.”
Philology Library, Foster + Partners, Free University of Berlin, Germany, 2005, 6290 m²

[Natural ventilation and light to create the perfect study environment]

The building is inserted by a blob-shape enclosure located in one of the courtyards of the Free Berlin University. The description of the project made by the design team emphasizes the will to provide the library with the “perfect environment to study”, allowing for a maximum of natural light and air inside the complex.

In this respect, the designed is formed by two main components: a massive concrete structure hosting books displays and study spaces and a light and diaphanous envelope which helps to regulate the quality of internal environment. In fact, the enveloped is clad with glass as well as with opaque aluminium panels following the sun path and therefore regulating solar incidence on the inside. Moreover, the interior membrane is made of a glass fibre acting as a diffuser to spread natural light thus creating a more comfortable type of illumination. Furthermore, this double skin characterising the enclosure acts as an “air duct and thermal buffer”, opening and closing different panels to allow natural ventilation and to regulate interior climate.\(^{(13)}\)

The organisation of the library is defined by the will to put the bookshelves in the middle, thus allowing for the study places to be spread around this core and harvest at the maximum the comfort of natural light and ventilation provided by the envelop enclosing the building.
University Library, Wiel Arets, Utrecth, Netherlands, 2004, 36250 m²

[A composition of different volumes between transparency and opaqueness]

The library consists of a compact block housing different functions, which are organised with a subtle composition of different volumes. A first hint of the presence of this series of various volumes on the inside is perceived in the designed of the facade. In fact, the envelope presents a play of alternating transparent and opaque panels, with a texture of jungle trees printed on the glass and carved in relief on the black concrete panels. On the inside, this play of volumes is further elaborated with the design of spaces which are light, open and transparent for circulation and other more public functions, alternated to volumes which appear as opaque, dark and cavernous. These volumes are “floating like stormy clouds throughout the main space”, hosting functions which require silence (auditorium, lecture rooms, study spaces) or absence of light (archives and book stack). Another important theme in the library is circulation, which is carried out through a big central staircase connecting the different volumes.

FACILITIES:
Individual and group study rooms (1,300 seats and 560 workstations);
Café and lounge;
Shops;
Auditorium;
Multiple stacks housing more than 4.2 million books;
Parking (500 spaces).
DESIGN

Interpreting - enhancing - transforming
6.1 - DESIGN APPROACH

Interpreting the existing with the aim of enhancing its qualities

The position structuring the approach of the graduation project consisted in the belief that, in order to maintain the important role of our architectural heritage as a signifier of our collective memory and identity, the task of the contemporary architect should be to integrate it within new interventions capable of reactivate and enhance the qualities of the existing. Moreover, the new intervention should be also related with contemporary issues such as sustainability and energy consumption in buildings.

Therefore, the aim of the design has been to intervene on the existing with the aim of enhancing the character, the architectural quality and the beauty which define. Thus, the application of the strategies for building upgrade analysed during the research was intended as an architectural tool capable of reshaping and intensifying the atmosphere of the existing building, connecting in this way more technical issues of energy saving with architectural ideas based on the perception of space and the feeling derived by it.

This process started with identifying and interpreting the qualities of the existing building, producing a series of starting points forming the backbone of the design which ultimately aimed at enhancing these qualities in a transformation of the building capable of generating a new “intensified atmosphere” derived by the profound dialogue between old and new.
STRUCTURE
This ensemble of vertical and horizontal white needles is the element that holds every aspect of the design together, making it possible to produce a wide variety of episodes in the intervention, while maintaining a unitary idea keeping everything in equilibrium. In fact, it enforces the rhythm of the existing windows and it defines the architectural character of the intervention, while also playing a fundamental role in the technical upgrade of the building, by holding the roof, collecting rain water and housing air ventilators.

SEQUENCE OF SPACES
The unfolding succession of covered entrance, enclosure walls, vertical promenade of platforms, and water produces a filtering of activities from places intended for gathering where a lot happens to places meant for contemplation where almost nothing happens.

LIGHT
The new cover is made of a double-skin roof with a cavity in-between, capable of upgrading the building by creating a microclimate ensuring the harvesting of solar energy. Moreover, a layer of paper is inserted in the cavity to achieve a warm and diffused light shaping the atmosphere of the interior.
6.2 - PROGRAMME

A new bookless library to complement and enforce the network of knowledge in the inner city

The new function will operate at the scale of the city, being inserted in the already existing ensemble of libraries and study spaces of the university. In particular, the aim of the project will not be to create a new central library, but to complement and reinforce this already existing network of facilities with the creation of a new member with a special character capable of adding new value to this group of buildings dedicated to knowledge sharing and production.

In fact, the aim of the programme will be the design of a library for the future, a new interpretation of this secular function related to the changing characteristics of contemporary society.

In this respect, the fact that the library will be bookless emphasizes the focusing on its character not as the storage of knowledge - since nowadays it is accessible to anyone with a web connection - but as a place which celebrates the production and the exchange of culture.

Thus, the building will not only be a library but a meeting point, a public living room in the context of the Binnengasthuis area, a place for public interaction, capable of offering different kinds of study spaces, ranging from a more crowded to a more secluded and quiet kind of study.
Covered entrance and café
Enclosure walls: reception, vending machines, printers
Atrium: space with the most public character
Interior study spaces (bicycle parking in the basement)
Lecture halls

New library
Existing libraries
Existing museums
UVA city as a campus network
New UVA related functions

LIBRARY

MEETING
Atrium; café

STUDYING
Different study spaces types
(More than 500 study seats)

UNIVERSITY
6 lecture halls (20, 30 and 40 seats)

LOGISTICS
Bike parking (more than 400 spots)
New staircases and elevators
Hierarchy of access points
6.3 - URBAN PLAN

Water as an architectural element defining the space

The urban design aims at improving the quality of the existing open spaces surrounding the building which, as described previously in the urban analysis, at the moment are characterized by a series of issues deriving mainly from the conflict between the public character of the university and privacy requirements of the surrounding housing units.

The design tackles these problems through the architectural element of water, by establishing a series of water lines to define the spaces inside and outside the building.

In particular, one of the stripes creates an intermediate area between library and housing, establishing a gradual transition from the public to the private spheres of living.

Furthermore, water is also used to give a definition to the square in front of the social housing complex, creating a place where people can seat and gather.

Water is also used in the interior of the new library building both for its architectural value - it is able to define the space enhancing the symmetry of the existing and creating a place for contemplation where the old is reflected in the new water surface - and its capability to keep the building cool during the summer.

These water lines function as urban gutters connected to the canals, so when it rains it will be possible to appreciate also the movement of water between the various parts of the site.
6.4 - RHYTHM, MOVEMENT AND LIGHT

The structure enhances, strengthens and exaggerates the rhythm of the existing building shaped by the succession of windows. Moreover, this forest of columns is also the element which keeps everything together, making it possible to maintain a unitary idea while producing a series of different episodes. These episodes constitute different actors in the design and are meant to define a movement throughout the building characterized by a sequence of different spaces forming a transition from business to silence, from gathering to contemplation.

- Entrance: covered meeting place on the outside and café inside
- Enclosure walls: a borderline hosting logistics and circulation.
- Platforms: a vertical succession of planes, staircases and ramps of satin glass, which follow and enhance the vertical rhythm of the limestone lines on the facade of the existing, while offering new and unexpected vistas, as well as an enigmatic play of transparency.
- Water: a place for contemplation adding value to the peculiarity of the existing round lecture hall and reflecting the existing building on its surface, thus offering a new perception of the old.
- Cover: a new warm and diffused light in the interior
WATER
The existing round volume of bricks is transformed by raising it with a new concrete layer which connects it to the new cover and makes it possible to have two double-storey lecture halls inside. The presence of water gives eloquence and greatly influence the perception and the atmosphere of the space.

COMPOSITION
The structure holds all the episodes characterizing the design in a unitary idea: the module of the columns is related to the rhythm of the existing building, shaped by the repetition of windows in the facade.
COMPOSITION OF THE FACADE
The design emphasizing a tension between the old and the new, as if a compressive force was pushing from the existing and holding the fragile volume of the café in equilibrium in-between the massive concrete blocks defining the staircases and the enclosure walls.
Entrance: a covered meeting place outside and café inside
Entrance: inviting hints of the interior
Platforms: a vertical succession of planes, staircases and ramps
Café: a warm atmosphere shaped by paper
Enclosure: the wall as a borderline but also as a place for circulation and logistics
STRUCTURE
Steel profiles coated in white
Purity and abstraction

PLATFORMS
Satin glass laminated and sound absorbing
Play of transparency and noise control

WATER
Define the architectural and urban space and enhance the perception of the existing
Climate control which avoids overheating in the summer

PAVEMENT
Polished granite (red for the lines and crystal moon for the surface)
Creation of a floor grid following and emphasizing the structure of columns

COVER
Shading in paper
A warm and diffuse light shape the interior atmosphere

CONCRETE VOLUMES
Enclosure walls, new elevators, round shape addition
Aggregates to define a colour which is in harmony with the existing brickwork

INTERIOR
Contrast between wood and concrete operating at different sensorial levels
(Visual, tactile, acoustic)

Materialization
Atrium: a multifunctional living room of suspended platforms

Possible configurations of a platform:
- Study spaces along the edge
- Temporary exhibitions with movable supports
- Armchairs and coffee tables for a more informal gathering
- Circulation shortcuts between the two existing wings
Platforms: surfaces of translucent satin glass create an enigmatic play of transparency in the atrium.
Platforms: the different levels and orientations of the planes provide new and unexpected vistas
Cover: a canopy of glass and paper creates a new warm and diffused light in the interior
Connection between the new and the old:

- 1. Attachment of the structure to the load-bearing walls leaving a gap from the existing gutter, giving the impression of the new structure delicately an effortlessly touching the old.
- 2. Connection between existing brickwork and concrete volumes leaving a distance which generates a shadow line marking the point where the two materials touch
- 3. Shadow line in plan
- 4. Composition of the cover so as to give value to the existing central brick volume, including it in the atrium and offering an interesting view of the whole facade from below
Interiors: study spaces with different atmospheres and characters in each room

- Attic study box
- Studiol
- Bookshelf
6.5 - INTERIORS

The design of the study spaces in the interiors of the existing building is determined by the same approach of interpretation of the characteristics of the old followed by the goal to enhance them in the new intervention.

In particular, this process of interpreting-enhancing-transforming focuses on the qualities of the former hospital rooms as shaped by the rhythm created by the repetition of the huge windows intended to ventilate the hospital spaces.

The various designs for the rooms relate to this feature and try to emphasize the existing rhythm with the repetition of new elements inserted in the old fabric. In particular, even if all the interventions enforce and exaggerate this repetition of elements, the interior rooms are treated with different design typologies, in order to provide the users with a variety of study spaces, each having different atmospheres and offering different possibilities for studying, ranging from common to secluded reading.

In terms of materials, concrete is used for the more structural side of the designs, whereas wood is intended for the study furniture, thus establishing an interesting contrast between these two opposite materials, a dichotomy operating on different sensorial levels (visual, tactile, auditive).

- Bookshelf
  This typology exploits the 4.60 m height of the existing hospital room, derived by the necessity for natural ventilation, with the creation of a series of study cells on two levels, forming a bookshelf of students.
- Niche
This type is also based on the creation of a series of study spaces based on two levels. In particular, the aim of the design is to create places to study on the “human scale”, each related to the windows. The shifting disposition of the study spaces allows to catch glimpses of what is happening on the other floors.

- Studiolo
The intervention focuses on the definition of the “room in the room”, creating separate spaces for common study, each related to one of the existing windows, which are replicated in the doors enclosing the rooms. Moreover, a series of seating spaces for individual reading is placed in the corridor, making the circulation space more interesting.

- Promenade
The rhythm of the windows is emphasized by the repetition of walls defining the study spaces. The doors connecting the various enclosures form an enfilade relating to the windows at the end of the room and establishing a promenade through the space.

- Attic typologies
In the design of the study spaces for the attic the will was to design a minimal intervention to preserve and enhance the beauty of the existing wooden construction characterizing the roof. Therefore, particular attention has been given to the furniture, which defines in one room a series of individual “study boxes”, and in the other one an array of tables hanging from the existing beams.
The graduation project was based on the study and application of innovative strategies for the technical upgrade of existing buildings to future standards of comfort and energy efficiency. In this respect, a series of strategies has been analysed with particular attention to their phenomenological characteristics, thus focusing on the ways their application could influence the atmosphere, the architectural perception, sensorial feeling and experience of the place. The study also paid attention to the technical advantages that these upgrading operations can provide to the building and this knowledge was used throughout the graduation project as the backbone of the design. In particular, the intervention operates an upgrade of the existing using mainly three strategies.

- **Covering**
  A double-skin cover is added to the courtyard providing the atrium with a new microclimate that will be capable to harvest solar energy in the winter, a controlled buffer zone to minimize energy use. To avoid overheating in the summer, a ventilated cavity has been designed in-between the two strata of glass, with a shading device made of a fixed thin layer of paper that would be able to filter and diffuse sunlight. Moreover, natural ventilation is made possible through openable windows in the roof and by exploiting the existing cross ventilation in the interior rooms. In addition, air ducts hidden in the structural beams can also provide mechanical ventilation when needed. Finally, the presence of water inside the atrium will also be capable to cool the building.

- **Addition of insulation inside**
  A new 8 cm layer of insulation has been placed in the interiors of the existing buildings on the side separating the rooms from the exterior. Furthermore, to minimize heat loss a new layer of glass has been placed behind the existing windows.

- **Networking: energy storage**
  An inter-seasonal heat and cold aquifer storage guarantees energy saving through the use of the cold stored from the previous winter for cooling in the summer, and of the warmth collected in the previous summer to minimize the energy required for heating in the winter. The aquifer is connected through pipes to the floor heating and cooling system used throughout the building.
- 9. Double-skin roof with ventilated cavity
- 10. Shading in paper
STRATIGRAPHY OF THE ROOF

1. Structural steel beams connected to the columns
2. Inner layer: acoustic single-glazed laminated glass pane, openable inward for maintenance and cleaning
3. Shading: layer of paper to diffuse and absorb sunlight
4. Secondary structure to separate the two glass layers, hollowed to ensure air passing through the ventilated cavity
5. Outer layer: fritted double-glazed laminated glass pane
1. Structure: steel coated white
2. Platform: sound-absorbing satin glass laminated
3. Parapet: sound-absorbing satin glass laminated
4. Frames: aluminium coated white
5. Water collector
6. Insulation
7. Steel Joint column-beam
8. Floor: insulated glass with paper inside the cavity
9. Plate with electric wires to avoid condensation on the inside
1. Connection to load bearing wall: plastic wedges
2. Connection to load bearing wall: steel profile
3. New gutter on the existing
4. Openable window to ventilate roof cavity
5. Air filter
6. Double-skin roof outer layer: double laminated fritted glass fixed (2% inclination)
7. Double-skin roof inner layer: single sound-absorbing glass openable for maintenance
8. Shading: layer of paper
9. Beam primary structure: steel coated white
10. Beam secondary structure: steel coated white, hollowed to ensure air passing through the ventilated cavity
11. Column: steel coated white
12. Rain water collector with insulation
13. Gutter leading the water to the adjacent column
14. Joint beam/column: bolts with space to move
15. Air extractors for mechanical ventilation
16. Fire safety sprinkles
CONCLUSION

Reflection paper
Introduction

The reflection paper aims at pondering upon the graduation process in its entirety, considering the relation between the research and the design parts of the project, as well as its progress and possible success. The graduation project has been focused on the intervention on an existing building, which the chair of Heritage and Architecture is specialized on; in particular the context has been characterized by the listed monuments of the Binnengasthuisterrein in Amsterdam. In this respect, the project aimed at considering the possibility of an intervention focused on the architectural use of strategies for building upgrade, in a way which, apart from improving the technical performance of the building ensemble, could be able to actively influence its architectural and urban qualities.

The why: relevance of the project

The discourse upon architectural sustainability is considered one of the most pressing issues of our time. In fact, phenomena such as climate change, the greenhouse effect and the harmful consequences of the use of fossil fuels suggest to reconsider the way we use our energy, especially in existing buildings. In this respect, as described in “Reimagining the envelope” (Knaack, U. Bilow, M. Konstantinou, T. Lieverse, B) it is possible to state that the relevance of the upgrade of our existing building stock is multifaceted.

First of all, the importance of this operation is ecological, since it has been proven that a reduction of the energy demand of existing buildings will result in a diminution in the emission of greenhouse gasses and pollutants.

Secondly, the relevance of building upgrade is economical, since the load bearing structure of existent constructions can last for centuries, and it would be wise to find a way to harvest this “stored capital”.

In addition, an upgrade intervention to prolong the life of existing buildings has a cultural and social relevance, since they represent documents of the past constituting fundamental pieces of our collective memory and identity.

The graduation project has been based on the position that an active intervention on our architectural heritage is necessary to keep history alive and preserve its value as a core for contemporary society. Therefore, a further degree of relevance arises concerning the architectural value of the intervention, which is defined by the ultimate relation between upgrade, the existing context and the architectural quality of the new design.
The challenge: relating new and old

The position which was emphasized in the approach characterizing the graduation project considered the city as a stage, where each building could be associated with an actor playing a role in the testimony of the past, thus characterizing our collective memory and identity.

In this respect, the role of the architect in contemporary society should be related to contributing to the preservation of this important societal role of our building fabric and, therefore, to intervene on the existing with the aim of enhancing the character, the architectural quality and the beauty which define it, through the interpretation and understanding of its characteristics and its ultimate transformation.

In this respect, sustainability has been defined as “balance”, an equilibrated relation between architectural and technical operations which aims at achieving an expression of beauty related to functionality as a ultimate goal.

“We should not live in a bright shiny new future, any more than we should live in a pastiche of the past. We must inhabit an ever evolving present, motivated by the possibility of change, restricted by the baggage of memory and experience”.
(David Chipperfield)

The how: methodology of the approach

The approach has been characterized by the close relationship between research and design. This cohesion made the graduation project valuable at all scales: from the definition of its general theoretical framework, through the study of the research theme, the site, the value assessment and the programme, until the design of the intervention on the urban, architectural and technical detailing levels.

This progression from the general to the particular has not been linear nor chronological, but the work has been focused on all scales in the entirety of the graduation process.

Design outcome

The design focused on interpreting, enhancing and transforming the architectural qualities of the existing building through a new intervention capable to strongly conjugate the urban, architectural and technical aspects of the design. The aim of the process has been to achieve a beautiful ensemble between new and old at all scales which could be capable of adding new value to the precious heritage characterised by the context.

In particular, the ideas grounding and shaping the concept of the design can be well summarised by the following keywords.
Rhythm: the interpretation of the existing building emphasized the repetition of the windows on the facade as a very strong element in its composition. Therefore, the new structure of columns has been designed as to follow, emphasize and strengthen this rhythm.

Movement: the new addition encloses the building and creates a sequence of spaces establishing a progression between outside, gate, enclosure, places for activities and places for contemplation in relation to the characteristics of the existing building.

Perception: the new design offers new perception of the existing on different sensorial levels. The new series of platforms creates a vertical spiralling path offering new vistas on the existing, whereas the presence and the movement of water offer a new acoustic experience. Moreover, the display of new materials such as concrete, steel, glass and paper provides an interesting combination of colours and textures with the existing brickwork.

Light: the new glass roof in the atrium, in combination with the shading device made of paper is capable to provide the courtyard with a new warm and diffuse light, which plays a fundamental role in defining and enhancing the qualities of the space.

Energy: the strategies for building upgrade work in combination with the architectural and urban design to achieve the ultimate goal of the cohesion between functionality and beauty, considering sustainability as balance derived from the tuning between all the aspects of the design.

Heritage: the role of history has been defined as an ever-changing stage of memory and identity on which contemporary architects need to actively intervene in order to maintain and intensify its role in contemporary society.

Atmosphere: the sensorial qualities intrinsic in the space or, as skillfully defined by Peter Zumthor, a “straightforward feeling about the building”. The cohesion between the different scales and elements of the intervention has been carried out with the aim of creating a new intensified atmosphere in the existing urban fabric and ultimately architectural quality deriving by the union of old and new.

In conclusion, it is possible to state that the graduation project was successful in the way all aspects of the research and design grew together and became strongly intertwined during this process. In fact, the final intervention was capable to meet the challenge posed by the research question in managing to apply innovative strategies for building upgrade in an architectural way focusing on their phenomenological qualities. In fact, the final intervention uses these strategies in the context of the existing urban fabric in a design which interprets, enhances and transforms its qualities, achieving a new intensified atmosphere from the relation between old and new.

“Quality in architecture is when a building manages to move me”
(Peter Zumthor)
REFERENCES AND IMAGE CREDITS