1. ARQUITECTONIC STRATEGIES - TAXONOMY

Order criteria based on the relation between the new layers added over the existing building so as to improve comfort and its energy efficiency. The entries are: on the x-axis the relation of proximity - new layers exempt regarding the existing enclosure or totally attached to it; in the y-axis the possibility of intervention either from the inside or the outside. Beside these main rows and columns appear some combined types as well as others considering intervening over more than one buildings close one to each other.

Outside space is the space where weather conditions are not controlled

Intermediate spaces are considered those spaces accessible not only for maintenance purposes but for developing activities related with the building program. The gap between the two layers of a double skin façade, even been accessible; its accessibility is limited to maintenance purposes so it cannot be considered an intermediate space.

Inside spaces are considered those spaces where the comfort conditions are optimal.
1.1. RESULTING TYPES

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>In/off</td>
<td>The new inside enclosure elements clad all the existing facades and roofs</td>
<td></td>
</tr>
<tr>
<td>Out/off</td>
<td>The new outside enclosure elements clad all the existing facades and roofs</td>
<td></td>
</tr>
<tr>
<td>In/ex</td>
<td>The new inside enclosure elements do not clad the existing facades and roofs</td>
<td></td>
</tr>
<tr>
<td>Out/ex</td>
<td>The new outside enclosure elements do not clad the existing facades and roofs</td>
<td></td>
</tr>
</tbody>
</table>

Combinations:

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>In/off+ex</td>
<td>The new inside enclosure elements clad some of the existing facades or roofs but not all</td>
<td></td>
</tr>
<tr>
<td>Out/off+ex</td>
<td>The new outside enclosure elements clad some of the existing facades or roofs but not all</td>
<td></td>
</tr>
<tr>
<td>In+Out /off</td>
<td>The new enclosure elements are placed in the inner and outer sides of the existing construction cladding all its facades and roofs</td>
<td></td>
</tr>
<tr>
<td>In+Out /ex</td>
<td>The new enclosure elements are placed in the inner and outer sides of the existing construction without cladding any of its façades or roofs</td>
<td></td>
</tr>
<tr>
<td>In+Out / off+ex</td>
<td>The new enclosure elements are placed in the inner and outer sides of the existing construction cladding some of its facades and roofs but not all</td>
<td></td>
</tr>
</tbody>
</table>

1.2. RESPONSE OF EACH OF THE SOLUTIONS RESULTING FROM THE MATRIX TO SOME MAIN ASPECTS RELEVANT ON THE ARCHITECTONIC DESIGN

<table>
<thead>
<tr>
<th></th>
<th>Image variation</th>
<th>Space variation</th>
<th>Energetic efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>From inside</td>
<td>From outside</td>
<td>Inside comfort volume dimension</td>
</tr>
<tr>
<td>In/off</td>
<td>total</td>
<td>no</td>
<td>scarcely reduced</td>
</tr>
<tr>
<td>Out/off</td>
<td>no</td>
<td>total</td>
<td>equal</td>
</tr>
<tr>
<td>In/ex</td>
<td>no</td>
<td>no</td>
<td>reduced</td>
</tr>
<tr>
<td>Out/ex</td>
<td>no</td>
<td>no</td>
<td>equal</td>
</tr>
</tbody>
</table>

Combinations:

<table>
<thead>
<tr>
<th></th>
<th>Image variation</th>
<th>Space variation</th>
<th>Energetic efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>From inside</td>
<td>From outside</td>
<td>Inside comfort volume dimension</td>
</tr>
<tr>
<td>In/off+ex</td>
<td>partial</td>
<td>no</td>
<td>reduced</td>
</tr>
<tr>
<td>Out/off+ex</td>
<td>no</td>
<td>partial</td>
<td>-</td>
</tr>
<tr>
<td>In+Out /off</td>
<td>partial</td>
<td>partial</td>
<td>equal</td>
</tr>
<tr>
<td>In+Out /ex</td>
<td>no</td>
<td>no</td>
<td>-</td>
</tr>
<tr>
<td>In+Out / off+ex</td>
<td>partial</td>
<td>partial</td>
<td>-</td>
</tr>
</tbody>
</table>
2. INDUSTRIAL BUILDING TYPES IN PORTO MARGHERA ACCORDING THE SPACE THEY GENERATE

In order to energetically refurbishing industrial buildings, and due to its normally wide dimensions, one of the main points to consider is determining which the space conditioned by mechanical means is going to be. Its definition depends on the future use of the building and will determine the architectonic strategy of the intervention. Obviously, the dimensions and proportions of the existing spaces limited by the exterior enclosures and the bearing partitions in the inside influence those decisions.

Thus, the dimensions and shape of the spaces inside the industrial buildings of Porto Marghera seem to as relevant so as to assess whether the theoretical refurbishing strategies resulting from the initial taxonomy are adequate or not. We have distinguished the following types:

- big buildings with no horizontal partitions _ (main dimension: horizontal)
- big buildings with no horizontal partitions _ (main dimension: vertical)
- buildings with horizontal partitions
- small buildings located close to each other

Besides this main approach, considering whether the existing building occupies or not the entire plot area gives us another input so as to choose between the different strategies. In fact this can be the first aspect to consider.

- Buildings occupying the whole site

2.1. BUILDINGS OCCUPYING THE WHOLE SITE

| The added volume can be placed on the top of the building (see Herzog & de Meuron). |
| No added volume. |

O: outside space / M: intermediate space / I: inside space according comfort requirements
2.1.1. Marghera cases

Even though the buildings occupying the area leave some free spaces, the average of open spaces regarding the occupied one suggest keeping free as much space as possible.

2.1.2. Examples

Caixa Forum Arts Center in Madrid by Herzog & de Meuron (2003-2008)

The site of the project was occupied by a power station and a petrol station. Well as the first could be considered a reminder of the city’s industrial age, the second did not. Herzog and de Meuron proposed refurbishing the existing power station improving the performances of the facade with an inside cladding. Besides, they enlarged its volume without occupying the limited open space surrounding the building just by adding two more floors over the existing structure. An important project decision was liberating the ground floor connecting it with the new small square placed where the petrol station used to be and, therefore, creating a promenade from the Paseo Castellana to the old town cross the building.
A completely different intervention is the one that Aires Mateus carry out in this former winery placed in a narrow plot and converted in single family house. Not only the existing building is much smaller but the dwelling program is simpler and intimate. The architects double the main longitudinal walls to the inside of the plan in the ground floor so as to house services liberating the main living space. Those walls also serve to support the added boxes that organise the night program on the upper part of the volume. Walls and boxes create attached spaces that filter the exterior climate conditions.

- 2007 Siza and architects in Portugal  A&U  no. 4 (439), 2007 Apr., p. 11-124
2.2. **BIG BUILDINGS WITH NO HORIZONTAL PARTITIONS** (main dimension: horizontal)

<table>
<thead>
<tr>
<th>OFFSET</th>
<th>EXEMPT</th>
<th>OFFSET + EXEMPT</th>
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<tbody>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
<td><img src="image3.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

- The optimization of the climate equipment demands not artificially heating or cooling the not accessible space at the upper part of the volume, so it is better defining inside comfort conditions spaces smaller than the main building.
- It exist the possibility of combining more than one strategy, for instances, passively conditioning the main space working on the existing enclosure and only heating or cooling by artificial means the new small spaces created (see Nieto & Sobejano).

2.2.1. Marghera cases

- Ex Agrimont
- Ex Azotati

O: outside space / M: intermediate space / I: inside space according comfort requirements
2.2.2. Examples

Nave industrial Embarcadero in Cáceres by Nieto & Sobejano (2011)

In / ex + In+Out / off

In the refurbishment of this dismissed construction with the objective of creating spaces for social and educational program, the architects used two different strategies:
- the replacement of the existing facade with a new translucent enclosure so as to improve climatic and lighting conditions in the intermediate space, and though in the inner ones, using passive systems;
- the creation of interior volumes dimensioned according to the program they house and with the possibility of being artificially heated or cooled independently.

– Tectónica, #35 2011
– Arquitectura Viva, #148 Enero 2013

Red Bull Music Academy, Nave 15 Matadero Madrid by María Langarita & Víctor Navarro (2011)

In / ex
The wide inside space of the existing building is occupied by small scale volumes apparently grouped at random. In fact, their disposition has been deeply studied so as to hierarchize different intermediate spaces according to the variation in the height of the existing warehouse. This space hierarchy admits developing the different activities that the program demands. Those added volume use dry construction techniques so they can easily be disassembled. Their enclosures satisfy all the comfort requirements, especially the acoustic ones, as the building is a centre for music creation.

CNR and Institute of Marine Science headquarters at the Arsenale in Venezia by Alberto Cecchetto (2004-2012)

Alberto Cecchetto, like Navarro and Langarita, occupies the existing building with new dry constructed volumes whose enclosures ensure the offices program comfort conditions. The existing building is consolidated and slightly modified with some new openings in the roof for better lighting conditions. The dimensions of the original building in relation to the new volumes that occupy it, and a rigid wall structure, restrict the possibilities of relationship between those new volumes leading the interest of the project to the relationship between them and the preexistence. Is in this perimeter that it is created the intermediate space that revalues the old building.
2.3. BIG BUILDINGS WITH NO HORIZONTAL PARTITIONS – (main dimension: vertical)

The optimization of the climate equipment demands not artificially heating or cooling the not accessible space at the upper part of the volume, so it is better defining inside comfort conditions spaces smaller than the main building.

It exist the possibility of combining more than one strategy, for instances, passively conditioning the main space working on the existing enclosure and only heating or cooling by artificial means the new small spaces created.

OFFSET | EXEMPT | OFFSET + EXEMPT

O: outside space / M: intermediate space / I: inside space according comfort requirements
2.3.1. Marghera cases

Ex Malteria

2.3.2. Examples

Museo Interactivo de la Historia de Lugo by Nieto & Sobejano (2007-20011)

In/ex + In+Out /off

The museum recycles two dismissed steel silos as the main iconic elements of the new building. The existing structures are clad with deployee mesh on the outside and doubled with new cylinder structures in the inside. Those nested new cylinders are doubled. One of them is attached to the old steel structure and supported on its bottom while the other hangs from the top of it. Even though this structural strategy is repeated in both old silos, its function is not the same. On the small one the nested cylinder is not accessible becoming a huge lantern; in the bigger this nested cylinder defines a small space hanging in the middle of the main exhibition room.

– http://www.lugo.es/ws/mihl/documentacion.jsp
– AV Monografias 146 (2010)
2.4. **BUILDINGS WITH HORIZONTAL PARTITIONS**

| The thermal envelope has no continuity as it is interrupted by slabs. |
| The continuous thermal envelope provides comfort to the whole existing volume regardless its current horizontal sectorization |

<table>
<thead>
<tr>
<th>OFFSET</th>
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<th>OFFSET + EXEMPT</th>
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<td><img src="image3" alt="Diagram" /></td>
</tr>
</tbody>
</table>

O: outside space / M: intermediate space / I: inside space according comfort requirements

2.4.1. **Marghera cases**

Ex Pilkington

Ex Sali Tabacchi
2.4.2. Examples

De Silo, Middelburg by Rothuizen-architecten (2012)

Toni-Areal Zurich, Switzerland by EM2N architects (2008–2014)

- http://www.em2n.ch/projects/toniareal

Halle 181, Lagerplatz Winterthur, Switzerland by Kilga Popp Architekten (2012-13)

- http://www.kilgapopp.ch/architektur.html
2.5. SMALL BUILDINGS LOCATED CLOSE TO EACH OTHER

Defining nested inner spaces independent from the existing walls is not easy in small buildings. Furthermore enlarging its occupied surface may easily lead to relate the different constructions.

Clearly establishing a relation between the different volumes is an interesting possibility to enhance the spaces.

2.5.1. MARGHERA CASES

Canale Brentella

Ex Fintitan
3. FROM THE ARQUITECTONIC STRATEGIES TO THE FAÇADE SYSTEM PROPOSAL

When defining different systems for each of the facade refurbishment strategies we observe that:

- The offset strategy adding new elements both from the inside and the outside is really common, mostly in windows;
- The existing wall thermal mass gives sense to some solutions that are scarcely efficient when this thermal mass does not exist.

According to that, on the one hand we have distinguished between:

- OFFSET, EVEN INSIDE OR OUTSIDE, WITH HIGH THERMAL MASS EXISTING ENCLOSURE
  solutions suitable for the offset strategy with high thermal mass, gathering together systems where the added elements are at the outside, the inside or both;
- OFFSET, EVEN INSIDE OR OUTSIDE, WITH LOW THERMAL MASS EXISTING ENCLOSURE
  solutions suitable also for the offset strategy but when thermal mass is low, again putting together systems where the added elements are at the outside, the inside or both.

On the other hand, we have studied the possibility of again separating the systems proposed whether the existing enclosure has high or low thermal mass but, in this occasion, for the “exempt” strategies. On both situations, either when adding new elements in the inside or the outside, having more or less thermal mass can modify the efficiency of the system but does not change its design. In this occasion then, systems are organised according strictly the taxonomy scheme.

- EXEMPT INSIDE
- EXEMPT OUTSIDE

The systems proposed hereon are so classified according the previous four cases and limited to them as the rest of the types shown in the taxonomy are just combinations of them.
3.1. OFFSET, EVEN INSIDE OR OUTSIDE, WHEN HAVING A HIGH THERMAL MASS EXISTING ENCLOSURE

**FACADE REFURBISHMENT STRATEGY – HIGH THERMAL MASS EXISTING ENCLOSURE**

**ARCHITECTONIC STRATEGY**

<table>
<thead>
<tr>
<th>OFFSET</th>
<th>EXEMPT</th>
<th>OFFSET + EXEMPT</th>
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</thead>
<tbody>
<tr>
<td><img src="image1" alt="Inspection" /></td>
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<tr>
<td><img src="image4" alt="Inspection" /></td>
<td><img src="image5" alt="Inspection" /></td>
<td><img src="image6" alt="Inspection" /></td>
</tr>
</tbody>
</table>

- O: outside space
- M: intermediate space
- I: inside space according comfort requirements

Developed in *taxonomy.doc* file

Decomposed climate exposure and refurbishment strategy situations according to the season and whether it is a sunny or cloudy day or night.

**Drawings in esquemas basicos.dwg file**

**Summer**

**Winter**
Resulting global refurbishment strategy as a conclusion of the decomposed study.

<table>
<thead>
<tr>
<th>PHENOMENON</th>
<th>ELEMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>direct radiation</td>
<td>window</td>
</tr>
<tr>
<td>reflected radiation</td>
<td>skylight</td>
</tr>
<tr>
<td>absorbed radiation</td>
<td>blind</td>
</tr>
<tr>
<td>reemitted radiation</td>
<td>thermal insulated blind</td>
</tr>
<tr>
<td>ventilation</td>
<td>light control screen</td>
</tr>
<tr>
<td>heat transmission resistance</td>
<td>thermal insulated shutter</td>
</tr>
</tbody>
</table>

Drawings in *esquemas basicos.dwg* file
# SYSTEMS

System proposal for each of the different facades (wall section + opening section)

<table>
<thead>
<tr>
<th>Facade</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>1-S off.h</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>2-S off h</td>
<td>finishing (ply sheet board)</td>
</tr>
<tr>
<td>3-S off h</td>
<td>thermal insulated blind</td>
</tr>
<tr>
<td>4-S off h</td>
<td>thermal insulated blind</td>
</tr>
<tr>
<td>E-W</td>
<td>5-E/W off h</td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>6-N off.h</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7-N off.h</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8-N off h</td>
</tr>
</tbody>
</table>

Drawings in esquemas basicos.dwg file
Notes:

i. All the examples illustrating the systems are just proposals. Slats, shutters, screens, windows, double skins, etc. can be designed in many other different ways according each project but always fulfilling the functions explained in each description.

ii. It exists the possibility of combining the solution applied to the window and the one applied to the wall in different ways. Illustrations hereon show just a logical combination.

For architectonic solutions check: http://filt3rs.net

PASSIVE STRATEGIES DESCRIPTION

1 – S.off.h

Improvement based on the construction of a DSF on the sun exposed facades with a movable sun protection over it.

System description

- Operable sun protection.
- Glass enclosure made by fix panes placed at some distance from the old façade and with operable openings for ventilation in the entire perimeter.
- Thermal insulation cladding the inner side of the existing wall.
- Inside thermal insulated shutter closing the existing window.

Behaviour

- Cold season
  Adding a glass façade over the old one allows creating a hot air camera thanks to greenhouse effect. This buffer space limits thermal losses but its optimal behaviour is conditioned by having either direct or diffuse radiation and by the effectiveness of the wall as a thermal storage to provide heat during the night. An added thermal insulation is so incorporated to grant comfort conditions during long cloudy winter periods. This thermal insulation does not permit stored heat reaching the inner living space so it can only be liberated towards the buffer space. Designing movable thermal insulated panels placed either at the inner side of the wall or at the outer may permit controlling the effect of thermal mass storage in the inner climate conditions (see 2 – S.off.h).
  Thermal losses through the openings are reduced due to this same buffer space and an insulated shutter placed in the inside. At night, the insulated shutters improve the climate efficiency of the system at the same time they avoid artificial lighting losses just by reflecting it back to the inside.
- Hot season
  The buffer space disappears just by allowing air to circulate through it opening the perimeter slats. Overheat outside the existing wall is so avoided. A movable sun protection placed over the glass enclosure obstructs sun radiation from getting through the glass inside the air camera and inside the inner space. Its design allows preserving some views to the outside. Window operability permits different ventilation volumes. This ventilation is conditioned by the general building energetic refurbishment strategy.
2 – S.off.h

Improvement based on the construction of a DSF on the sun exposed facades with a movable reflective sun protection between the old enclosure and the glass one.

System description
- Glass enclosure made by rotating slats placed at some distance from the old façade.
- Operable high reflective sun protection placed between the old enclosure and the new glass one.
- Thermal insulated movable panels cladding the inner face of the wall.
- Inside thermal insulated shutter closing the window.

Behaviour
- Cold season
  Adding a glass façade over the old one allows creating a hot air camera thanks to greenhouse effect. This buffer space limits thermal losses but its optimal behaviour is conditioned by having either direct or diffuse radiation and by the effectiveness of the wall as a thermal storage to provide heat during the night. An added thermal insulation is so incorporated to grant comfort conditions during long cloudy winter periods. This thermal insulation does not permit stored heat reaching the inner living space so it can only be liberated towards the buffer space. Designing movable thermal insulated panels placed either at the inner side of the wall or at the outer may permit controlling the effect of thermal mass storage in the inner climate conditions.
  Thermal losses through the openings are reduced due to this same buffer space and an insulated shutter placed in the inside. At night, the insulated shutters improve the climate efficiency of the system at the same time they avoid artificial lighting losses just by reflecting it back to the inside.
- **Hot season**
  The buffer space disappears just by rotating the glass slats. Overheat outside the wall is so avoided. A screen obstructs sun radiation from getting inside the building preserving the views to the outside due to a certain degree of transparency. Its high reflective finishing helps avoiding overheating. Window operability permits different ventilation volumes. This ventilation is conditioned by the general building energetic refurbishment strategy.

3 – S.off.h

Improvement based on the construction of a DSF on the sun exposed facades with movable high reflective thermal insulated slats in the space generated between it and the old massive wall.

**System description**
- Glass enclosure made by fix panes placed at some distance from the old façade and with operable openings for ventilation in the entire perimeter.
- Operable thermal insulated and high reflective sun protection placed between the old enclosure and the new glass one.
- Inside light control screen behind the windows.

**Behaviour**

- **Cold season**
  Adding a glass façade over the old one allows creating a hot air camera thanks to greenhouse effect. This buffer space limits thermal losses but its optimal behaviour is conditioned by having either direct or diffuse radiation and by the effectiveness of the wall as a thermal storage to provide heat during the night. An added thermal insulation is so incorporated to grant comfort conditions during long cloudy winter periods. This thermal insulation in this occasion is placed over the exterior side of the existing wall, between it and the glass enclosure. It consists in horizontal slats. Its mobility permits either collecting energy from the sun when being opened, or insulating the wall and thus the inside space when closed. Thermal losses through the openings are reduced due to this same system, the buffer space and the thermal insulated slats.

- **Hot season**
  The buffer space disappears just by allowing air to circulate through it opening the perimeter. The insulated slates are opened and rotated so as to obstruct sun radiation from arriving to the wall or the inside of the building. Their high reflective finishing helps avoiding overheating. A screen placed in the inside of the windows permit controlling the light entering the building while preserving some views to the outside due to a certain degree of transparency. Window operability permits different ventilation volumes. This ventilation is conditioned by the general building energetic refurbishment strategy.

![Drawings in 3 S off h.dwg file](https://www.example.com/drawings.png)
4 – S.off.h

Improvement based on the disposal of movable thermal insulated slats over the outer side of the existing wall.

System description

- Movable thermal insulated slats over the exterior side of the wall.
- Inside light control screen behind the windows.

Behaviour

- Cold season
  When having enough sun radiation the slats are open and oriented parallel to direct sun radiation rays direction so as not to obstruct them. The wall can then store energy. At night or during cold cloudy days, the slats rotate to its closed position parallel to the main wall. The wall, and thus the building, is now thermally insulated and so the heat previously stored is kept in the inside. Those slats can either cover the windows but with independent mobility for having light and views.

- Hot season
  Slats rotate to its position perpendicular to direct sun radiation rays obstructing them so as they cannot reach either the wall or the inside of the building. An inner screen helps to control lighting preserving the views to the outside due to a certain degree of transparency. Window operability permits different ventilation volumes. This ventilation is conditioned by the general building energetic refurbishment strategy.

![Drawings](4 S off h.dwg file)
5 – E/W.off.h

Improvement based on the insulation of the wall with low thermal transmission material at the same time that it is protected from sun radiation with a hanged cladding generating a ventilated camera.

System description
- Open joint cladding.
- Ventilated camera.
- Thermal insulation material over the wall on its outside surface.
- Movable sun protection in front of the windows.

Light control and added thermal insulation in the openings can be achieved in two different ways:
- Double glass windows behind the existing ones.
- Inside light control screen.

Or
- Thermal insulated shutter behind the existing windows.

Behaviour
- Cold season
  When sun collection is not possible due to few insulation hours, the best strategy during cold seasons is insulating. Insulation material placed over the existing wall in the outside surface is the best way to avoid thermal bridges and condensation in the inside. The massive wall stays inside the thermal envelope so its thermal inertia is used for storing energy from the building’s heating system softening thermal changes. Insulation in the openings can either be improved incorporating a new double glass window behind the existing one or just a thermal insulated shutter.

- Hot season
  Even sun insulation hours are not enough so as to considering sun collection as the main strategy, a ventilated camera created behind a hanged cladding will avoid overheat early in the morning and in the afternoon in hot seasons. An exterior movable sun protection will prevent radiation from getting inside the inner space. Combing it with either the thermal shutter or an inside screen will permit controlling light conditions. Window operability permits different ventilation volumes. This ventilation is conditioned by the general building energetic refurbishment strategy.

Summer
Filtering possibilities
- Outside
- Inside
6 – N.off.h

 Improvement based on the insulation of the wall with low thermal transmission material. In this façade the hanged cladding is just a finishing element. The camera has any purpose: there is not direct sun radiation (not ventilation needed); and water tightness was already solved in the existing building (not draining needed).

 **System description**

 - Open joint cladding.
 - Thermal insulation material over the wall on its outside surface.
 - Added double glass windows behind the existing ones.
 - Inside light control screen.

 **Behaviour**

 - Cold season

 When sun collection is not possible, the best strategy during cold seasons is insulating. Insulation material placed over the existing wall in the outside surface is the best way to avoid thermal bridges
and condensation in the inside. The massive wall stays inside the thermal envelope so its thermal inertia is used for storing energy from the building’s heating system softening thermal changes. Insulation in the openings can be improved incorporating new double glass window behind the existing ones. The added window restricts thermal losses through the openings not only thanks to its double glass but because of the camera generated between itself and the old window.

- **Hot season**
  
  Direct sun radiation protection is not necessary in North facades, however, we need to consider the effect over the building of reflected radiation. Light control elements are necessary either for those reflected rays or for diffuse radiation. An interior blind permits light control while keeps views from the outside thanks to its transparency. Window operability permits different ventilation volumes. This ventilation is conditioned by the general building energetic refurbishment strategy.

    ![Summer Filtering possibilities](6 N off h.dwg)
    - Outside
    - Inside

    ![Winter Filtering possibilities](6 N off h.dwg)
    - Outside
    - Inside

---

**7 – N.off.h**

Improvement based on the insulation of the wall with low thermal transmission material covered with a rendering. Being a really good energetic refurbishment strategy, it is the most architectonically conservative option (it allows preserving the outside building’s image).

**System description**

- **ETICS-** External thermal insulation construction system at the blind part of the façade. This system includes a rendered finishing that allows keeping the image the building had originally.
- Thermal insulated shutter in front of the window.
- Inside light control screen behind the window.
Behaviour

- Cold season
  When sun collection is not possible, the best strategy during cold seasons is insulating. Insulation material placed over the existing wall in the outside surface is the best way to avoid thermal bridges and condensation in the inside. The massive wall stays inside the thermal envelope so its thermal inertia is used for storing energy from the building’s heating system softening thermal changes. The rendering finishing gives the same image as the ancient building had. Insulation in the openings can be improved incorporating an insulated shutter.

- Hot season
  Direct sun radiation protection is not necessary in North facades, however, we need to consider the effect over the building of reflected radiation. Light control elements are necessary either for those reflected rays or for diffuse radiation. An interior blind permits light control while keeps views from the outside thanks to its transparency. Window operability permits different ventilation volumes. This ventilation is conditioned by the general building energetic refurbishment strategy.

Drawings in 7 N off h.dwg file

8 – N.off.h

Improvement based on the insulation of the facade with low thermal transmission material placed over the inner side of the wall.

System description

- Thermal insulation placed in the inside over the wall.
- Thermal insulated shutter behind the window.
- Light control screen in front of the window.

Behaviour

- Cold season
  When sun collection is not possible, the best strategy during cold seasons is insulating. Placing thermal insulation material over the inner side of the wall permits keeping the façade image unchanged from the outside but is not a good solution so as to avoid thermal bridges through slabs reaching the façade. Besides that, this solution needs strict control of possible inside condensation. Insulation in the openings can be improved incorporating an insulated shutter.

13 Systems
- Hot season

Direct sun radiation protection is not necessary in North facades, however, we need to consider the effect over the building of reflected radiation. Light control elements are necessary either for those reflected rays or for diffuse radiation. An exterior blind permits light control while keeps views from the outside thanks to its transparency. Window operability permits different ventilation volumes. This ventilation is conditioned by the general building energetic refurbishment strategy.

Drawings in 8 N off h.dwg file

<table>
<thead>
<tr>
<th>Summer Filtering possibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Outside</td>
</tr>
<tr>
<td>- Inside</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Winter Filtering possibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Outside</td>
</tr>
<tr>
<td>- Inside</td>
</tr>
</tbody>
</table>
3.2. OFFSET, EVEN INSIDE OR OUTSIDE, WHEN HAVING A LOW THERMAL MASS EXISTING ENCLOSURE

**FACADE REFURBISHMENT STRATEGY – LOW THERMAL MASS EXISTING ENCLOSURE**

Decomposed climate exposure and refurbishment strategy situations according to the season and whether it is a sunny or cloudy day or night.

---

**PHENOMENON**
- direct radiation
- diffuse radiation
- absorbed radiation
- transmitted radiation
- ventilation
- heat transmission resistance

**ELEMENTS**
- massive wall high thermal mass
- thin wall poor thermal mass
- exempt cladding
- operable glass enclosure
- thermal insulation material
- finishing
- window
- skylight
- blind
- thermal insulated blind
- light control screen
- thermal insulated shutter
- thermal curtain / acoustic absorber

---

Resulting global refurbishment strategy as a conclusion of the decomposed study.

**EXISTING CONSTRUCTION**

**ENERGETIC REFURBISHMENT**

---

*Drawings in esquemas basicos.dwg file*
SYSTEMS

System proposal for each of the different facades (wall section + opening section)

1-S.off.I
- existing wall
- thermal insulation
- cladding
- light control screen
- double glass window
- existing window
- blind
  (movable sun protection)
- thermal insulated shutter
- existing window
- blind
  (movable sun protection)

2-E/W.off.I
- existing wall
- thermal insulation
- cladding
- light control screen
- double glass window
- existing window
- blind
  (movable sun protection)
- thermal insulated shutter
- existing window
- blind
  (movable sun protection)

3-N.off.I
- existing wall
- thermal insulation
- cladding
- light control screen
- double glass window
- existing window

4-N.off.I
- existing wall
- thermal insulation
- finishing (rendering)
- light control screen
- double glass window
- existing window
- thermal insulated shutter

5-N.off.I
- existing wall
- thermal insulation
- finishing (gypsum board)
- light control screen
PASSIVE STRATEGIES DESCRIPTION

1 – S.off.l

Improvement based on the insulation of the wall with low thermal transmission material at the same time that it is protected from sun radiation with a hanged cladding generating a ventilated camera.

System description
- Open joint cladding.
- Ventilated camera.
- Thermal insulation material over the wall on its outside surface.
- Movable sun protection in front of the window.

Light control and added thermal insulation in the openings can be achieved in two different ways:
- Double glass windows behind the existing ones.
- Inside light control screen.

Or
- Thermal insulated shutter behind the existing windows.

Behaviour
- Cold season
  When the wall thermal mass is scarce it has no sense thinking on it as a heat storage. Sun collection is then produced through the window but not in the wall. In those situations the best strategy during cold seasons is insulating. Insulation material placed over the existing wall in the outside surface is the best way to avoid thermal bridges and condensation in the inside. Insulation in the openings can either be improved incorporating a new double glass window behind the existing one or just a thermal insulated shutter.
- Hot season
  Even having insulated the wall the best strategy in summer conditions is generating a sun screen. A ventilated camera created behind a hanged cladding will avoid overheat. Over the window, an exterior movable sun protection will prevent radiation from getting inside the inner space. Combined with either the thermal shutter or an inside screen permits controlling light conditions. Window operability allows different ventilation volumes. This ventilation is conditioned by the general building energetic refurbishment strategy.

Summer
Filtering possibilities
- Outside
- Inside
2 – E/W.off.l

Improvement based on the insulation of the wall with low thermal transmission material at the same time that it is protected from sun radiation with a hanged cladding generating a ventilated camera.

System description
- Open joint cladding.
- Ventilated camera.
- Thermal insulation material over the wall on its outside surface.
- Movable sun protection in front of the window.

Light control and added thermal insulation in the openings can be achieved in two different ways:
- Double glass windows behind the existing ones.
- Inside light control screen.

Or
- Thermal insulated shutter behind the existing windows.

Behaviour
- Cold season
  The best strategy during cold seasons is insulating. Insulation material placed over the existing wall in the outside surface is the best way to avoid thermal bridges and condensation in the inside.
Insulation in the openings can either be improved incorporating a new double glass window behind the existing one or just a thermal insulated shutter.

- Hot season

Even having insulated the wall the best strategy in summer conditions during the sunset and sunrise is generating a sun screen. A ventilated camera created behind a hanged cladding will avoid overheat. Over the window, an exterior movable sun protection will prevent radiation from getting inside the inner space. Combined with either the thermal shutter or an inside screen permits controlling light conditions. Window operability allows different ventilation volumes. This ventilation is conditioned by the general building energetic refurbishment strategy.

Drawings in 2 EW off l.dwg file
3 – N.off.l

Improvement based on the insulation of the wall with low thermal transmission material. In this façade the hanged cladding is just a finishing element. The camera has any purpose: there is not direct sun radiation (not ventilation needed); and water tightness was already solved in the existing building (not draining needed).

System description
- Open joint cladding.
- Thermal insulation material over the wall on its outside surface.
- Added double glass windows behind the existing ones.
- Inside light control screen.

Behaviour
- Cold season
  Insulation material placed over the existing wall in the outside surface is the best way to avoid thermal bridges and condensation in the inside. Insulation in the openings can be improved incorporating a new double glass window behind the existing one. The added window restricts thermal losses through the openings not only thanks to its double glass but because of the camera generated between itself and the old window.
- Hot season
  Direct sun radiation protection is not necessary in North facades, however, we need to consider the effect over the building of reflected radiation. Light control elements are necessary either for those reflected rays or for diffuse radiation. An inside blind permits light control while keeps views from the outside thanks to its transparency. Window operability permits different ventilation volumes. This ventilation is conditioned by the general building energetic refurbishment strategy.

Drawings in 3 N off l.dwg file
4 – N.off.l
Improvement based on the insulation of the wall with low thermal transmission material covered with a rendering. Being a really good energetic refurbishment strategy, it is the most architectonically conservative option (it allows preserving the outside building's image).

System description
- ETICS- External thermal insulation construction system at the blind part of the façade. This system includes a rendered finishing that allows keeping the image the building had originally.
- Thermal insulated shutter in front of the window.
- Inside light control screen behind the window.

Behaviour
- Cold season
Insulation material placed over the existing wall in the outside surface is the best way to avoid thermal bridges and condensation in the inside. The rendering finishing gives the same image as the ancient building had. Insulation in the openings can be improved incorporating an insulated shutter.
- Hot season
Direct sun radiation protection is not necessary in North facades, however, we need to consider the effect over the building of reflected radiation. Light control elements are necessary either for those reflected rays or for diffuse radiation. An inside blind permits light control while keeps views from the outside thanks to its transparency. Window operability permits different ventilation volumes. This ventilation is conditioned by the general building energetic refurbishment strategy.

5 – N.off.l
Improvement based on the insulation of the facade with low thermal transmission material placed on the inner side of the wall.

System description
- Thermal insulation placed in the inside over the wall.
- Thermal insulated shutter behind the window.
- Light control screen in front of the window.

Summer
Filtering possibilities
- Outside
- Inside

Winter
Filtering possibilities
- Outside (night)
- Inside

Drawings in 4 N off l.dwg file

21 Systems
Behaviour

- Cold season
  Placing thermal insulation material over the inner side of the wall permits keeping the façade image unchanged but is not a good solution for avoiding the thermal bridge that slabs can generate when reaching the façade. Besides that, this solution needs strict control of possible inside condensation. Insulation in the openings can be improved incorporating an insulated shutter.

- Hot season
  Direct sun radiation protection is not necessary in North facades, however, we need to consider the effect over the building of reflected radiation. Light control elements are necessary either for those reflected rays or for diffuse radiation. An exterior blind permits light control while keeps views from the outside thanks to its transparency. Window operability permits different ventilation volumes. This ventilation is conditioned by the general building energetic refurbishment strategy.

Drawings in S N off.l.dwg file

Summer
Filtering possibilities
- Outside
- Inside

Winter
Filtering possibilities
- Outside
- Inside
### 3.3. EXEMPT IN THE INSIDE

**ARCHITECTONIC STRATEGY**

![Offset, Exempt, Offset + Exempt strategies]

<table>
<thead>
<tr>
<th>Offset</th>
<th>Exempt</th>
<th>Offset + Exempt</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
<td><img src="image3.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

- O: outside space / M: intermediate space / I: inside space according comfort requirements

Developed in `taxonomy.doc` file

### FACADE REFURBISHMENT STRATEGY – EXEMPT INSIDE

Decomposed climate exposure and refurbishment strategy situations according to the season and whether it is a sunny or cloudy day or night.

#### Summer

![Summer Diagram](image4.png)

#### Winter

![Winter Diagram](image5.png)

Drawings in `esquemas basics.dwg` file
Resulting global refurbishment strategy as a conclusion of the decomposed study.

**PHENOMENON**
- direct radiation
- diffuse radiation
- absorbed radiation
- reemitted radiation
- ventilation
- heat transmission resistances

**ELEMENTS**
- massive wall
- high thermal mass
- thin wall
- poor thermal mass
- exempt cladding
- operable glass enclosure
- thermal insulation material
- finishing
- window
- skylight
- blind
- thermal insulated blind
- light control screen
- thermal insulated shutter
- thermal curtain / acoustic absorber

Drawings in *esquemas basicos.dwg* file

**SYSTEMS**
System proposal for each of the different facades (wall section + opening section)
**PASSE STRATEGIES DESCRIPTION**

1 – S.ex.inn

Improvement based on the creation of an inside close space defined by a multilayer lightweight enclosure formed by movable elements.

**System description**

- Intervention over the existing wall
  - High reflective and movable blinds behind the existing windows.
- Exempt intervention
  - Insulated practicable panels.
  - Orientable slats modules.
  - Double glass practicable panes.
  - Thick curtain.

**Behaviour**

- Cold season
  - During the cold season the existing building acts as a sun radiation collector softening the thermal changes from night and day. On sunny days the existing wall will store heat during the day liberating it at night. The effect of this massive construction will help to regulate the temperature in the inside. Heat collection due to greenhouse effect is going to be produced through the big windows. In the inside, the new lightweight constructed volume will be rapidly heat by mechanical means. Comfort temperature will be maintained due to the thermal insulation material and double glass panes.
thick curtain will improve thermal insulation just by covering the whole enclosure from the inside. This curtain helps as well to avoid reverberation in these spaces.

- **Hot season**
  During the hot season, the existing building acts as an umbraculum. The new lightweight constructed volume is protected from direct insolation and placed in a highly ventilated space. The insulated walls and glasses that form this new enclosure can be opened leaving as the only limiting element the orientable slats modules. Air can flow through these modulus. When more acoustic insulation will be needed, the thick curtain will be suitably placed creating gathered absorbent spaces while keeping some ventilation.

2 – **E/W.ex.inn**

Improvement based on the creation of an inside close space defined by a multilayer lightweight enclosure formed by movable elements.

**System description**

- Intervention over the existing wall
  - **ETICS-** External thermal insulation construction system at the blind part of the façade. This system includes a rendered finishing that allows keeping the image the building had originally.
  - Thermal insulated shutter in front of the window.
- High reflective and movable blinds behind the existing windows
- Exempt intervention
- Insulated practicable panels.
- Orientable slats modules.
- Double glass practicable panes.
- Thick curtain.

**Behaviour**

- **Cold season**
  The massive wall, insulated from the exterior, limits energy losses while avoiding low superficial temperatures in the inside. Losses through the windows are as well limited by thermal insulated shutters. In the inside, the new lightweight constructed volume will be rapidly heat by mechanical means. Comfort temperature will be maintained due to the thermal insulation material and double glass panes. A thick curtain will improve thermal insulation just by covering the whole enclosure from the inside. This curtain helps as well to avoid reverberation in these spaces.

- **Hot season**
  During the hot season, the existing building acts as an umbraculum. The new lightweight constructed volume is protected from direct insolation and placed in a ventilated space. The insulated walls and glasses that form this new enclosure can be opened leaving as the only limiting element the orientable slats modules. Air can flow through these modules. When more acoustic insulation will be needed, the thick curtain will be suitably placed creating gathered absorbent spaces while keeping some ventilation.

summer
3 – N.ex.in

Improvement based on the creation of an inside close space defined by a multilayer lightweight enclosure formed by movable elements.

System description

Intervention over the existing wall
- ETICS- External thermal insulation construction system at the blind part of the façade. This system includes a rendered finishing that allows keeping the image the building had originally.
- Thermal insulated shutter in front of the window.

Exempt intervention
- Insulated practicable panels.
- Orientable slats modules.
- Double glass practicable panes.
- Thick curtain.

Behaviour
- Cold season
  The massive wall, insulated from the exterior face, limits energy losses while avoiding low superficial temperatures in the inside. Losses through the windows are as well limited by thermal insulated shutters. In the inside, the new lightweight constructed volume will be rapidly heat by mechanical means. Comfort temperature will be maintained due to the thermal insulation material and double glass panes. A thick curtain will improve thermal insulation just by covering the whole enclosure from the inside. This curtain helps as well to avoid reverberation in the working spaces.

- Hot season
  During the hot season, the existing building acts as an umbraculum. The new lightweight constructed volume is protected from direct insolation and placed in a ventilated space. The insulated walls and glasses that form this new enclosure can be opened leaving as the only limiting element the orientable slats modules. Air can flow through these modules. When more acoustic insulation will be
needed, the thick curtain will be suitably placed creating gathered absorbent spaces while keeping some ventilation.

summer

winter

Drawings in 3 N ex inn.dwg file
3.4. EXEMPT IN THE OUTSIDE

ARCHITECTONIC STRATEGY

Developed in taxonomy.doc file

FACADE REFURBISHMENT STRATEGY – EXEMPT OUTSIDE

Decomposed climate exposure and refurbishment strategy situations according to the season and whether it is a sunny or cloudy day or night.

Drawings in esquemas basicos.dwg file
Resulting global refurbishment strategy as a conclusion of the decomposed study.

**PHENOMENON**

- direct radiation
- diffuse radiation
- absorbed radiation
- reradiated radiation
- ventilation
- heat transmission resistance

**ELEMENTS**

- window
- skylight
- blind
- thermal insulated blind
- light control screen
- thermal insulated shutter
- thermal curtain / acoustic absorber

Drawings in *esquemas basicos.dwg* file
<table>
<thead>
<tr>
<th>Systems</th>
<th>SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>System proposal for each of the different facades (wall section + opening section)</td>
<td></td>
</tr>
</tbody>
</table>

### S

<table>
<thead>
<tr>
<th>1-S ex.out</th>
<th>Thermal insulated shutter</th>
<th>Operable double glass enclosure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing wall</td>
<td>Existing wall</td>
<td>Operable double glass enclosure</td>
</tr>
<tr>
<td>Blind</td>
<td>Blind</td>
<td>Operable double glass enclosure</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2-S ex.out</th>
<th>Thermal insulated shutter</th>
<th>Operable double glass enclosure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing wall</td>
<td>Existing wall</td>
<td>Operable double glass enclosure</td>
</tr>
<tr>
<td>Blind</td>
<td>Blind</td>
<td>Operable double glass enclosure</td>
</tr>
<tr>
<td>Blind</td>
<td>Blind</td>
<td>Operable double glass enclosure</td>
</tr>
</tbody>
</table>

### E-W

<table>
<thead>
<tr>
<th>3-E/W ex.out</th>
<th>Thermal insulated shutter</th>
<th>Operable double glass enclosure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing wall</td>
<td>Existing wall</td>
<td>Operable double glass enclosure</td>
</tr>
<tr>
<td>Blind</td>
<td>Blind</td>
<td>Operable double glass enclosure</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4-E/W ex.out</th>
<th>Thermal insulated shutter</th>
<th>Operable double glass enclosure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing wall</td>
<td>Existing wall</td>
<td>Operable double glass enclosure</td>
</tr>
<tr>
<td>Blind</td>
<td>Blind</td>
<td>Operable double glass enclosure</td>
</tr>
<tr>
<td>Blind</td>
<td>Blind</td>
<td>Operable double glass enclosure</td>
</tr>
</tbody>
</table>
1 – S.ex.out

Improvement based on the creation of a perimeter buffer intermediate space acting as a greenhouse in winter and an umbraculum in summer.

System description

Exempt intervention
  - Orientable slats radiation protection.
  - Double glass practicable enclosure.
Intervention over the existing wall
  - Movable thermal insulation panels over the inner side of the wall.
  - Light control blinds in front of the windows.
  - Thermal insulated shutter behind the windows.

Behaviour

  - Cold season
    During cold season, the new glass enclosure performs as a greenhouse improving the thermal conditions in the inside of the ancient construction by decreasing the temperature difference between the two sides of its walls. However, thermally insulating those existing walls is needed so as to grant comfort conditions when sun radiation is not enough. This thermal insulation is placed in the inside of the existing wall so as to keep seen the ancient building from the new intermediate space created. It is formed by movable panels so as to permit benefit the inside space of the thermal inertia of the wall just by opening them, or creating a nearly continuous thermal insulated enclosure when being closed.

  - Hot season
    During the hot season, the new construction performs as an umbraculum. The glass panes are opened to permit ventilation at the same time that the orientated slats placed in front of them avoid sun radiation from getting into either the newly created intermediate space or the inside one. Blinds in front of the windows in the existing building permit lighting control while preserving some views due to its transparency.
2 – S.ex.out
Improvement based on the creation of a perimeter buffer intermediate space acting as a greenhouse in winter and an umbraculum in summer.

System description

Exempt intervention
- Double glass practicable enclosure.
- Orientable high reflective slats for radiation protection.

Intervention over the existing wall
- Movable thermal insulation panels over the inner side of the wall.
- Light control blinds in front of the windows.
- Thermal insulated shutter behind the windows.

Behaviour
- Cold season
During cold season, the new glass enclosure performs as a greenhouse improving the thermal conditions in the inside of the ancient construction by decreasing the temperature difference between the two sides of its walls. However, thermally insulating those existing walls is needed so as to grant comfort conditions when sun radiation is not enough. This thermal insulation is placed in the inside of the existing wall so as to keep seen the ancient building from the new intermediate space created. It is formed by movable panels so as to permit benefit the inside space of the thermal inertia of the wall just by opening them, or creating a nearly continuous thermal insulated enclosure when being closed.

- Hot season
  During the hot season, the new construction performs as an umbraculum. The glass panes are opened to permit ventilation at the same time that the orientated slats placed behind them avoid sun radiation from getting into either the newly created intermediate space or the inside one. Its reflective finishing avoid overheating. Blinds in front of the windows in the existing building permit lighting control while preserving some views due to its transparency.

\[\text{Drawings in ~}2S\text{~ex~out.dwg~file}\]
3-E/W.ex.out

Improvement based on the creation of a perimeter buffer intermediate space acting as a greenhouse in winter and an umbraculum in summer.

System description

- Exempt intervention
  - Orientable slats radiation protection.
  - Double glass practicable enclosure.
- Intervention over the existing wall
  - Movable thermal insulation panels over the inner side of the wall.
  - Light control blinds in front of the windows.
  - Thermal insulated shutter behind the windows.

Behaviour

- Cold season
  During cold season, the new glass enclosure performs as a greenhouse improving the thermal conditions in the inside of the ancient construction by decreasing the temperature difference between the two sides of its walls. However, thermally insulating those existing walls is needed so as to grant comfort conditions when sun radiation is not enough. This thermal insulation is placed in the inside of the existing wall so as to keep seen the ancient building from the new intermediate space created. It is formed by movable panels so as to permit benefit the inside space of the thermal inertia of the wall just by opening them, or creating a nearly continuous thermal insulated enclosure when being closed.

- Hot season
  During the hot season, the new construction performs as an umbraculum. The glass panes are opened to permit ventilation at the same time that the orientated slats placed in front of them avoid sun radiation during the sunrise and sunset from getting into either the newly created intermediate space or the inside one.
  Blinds in front of the windows in the existing building permit lighting control while preserving some views due to its transparency.
4-E/W.ex.out

Improvement based on the creation of a perimeter buffer intermediate space acting as a greenhouse in winter and an umbraculum in summer.

System description
Exempt intervention
- Orientable glass slats.
- Highly reflective curtain.
Intervention over the existing wall
- Movable thermal insulation panels over the inner side of the wall.
- Light control blinds in front of the windows.
- Thermal insulated shutter behind the windows.

Behaviour
- Cold season
  During cold season, the new glass enclosure performs as a greenhouse improving the thermal conditions in the inside of the ancient construction by decreasing the temperature difference between the two sides of its walls. However, thermally insulating those existing walls is needed so as to grant comfort conditions when sun radiation is not enough. This thermal insulation is placed in the inside of the existing wall so as to keep seen the ancient building from the new intermediate space. It is formed by movable panels so as to permit benefit the inside space of the thermal inertia of the wall just by opening them, or creating a nearly continuous thermal insulated enclosure when being closed.
- Hot season
  During the hot season, the new construction performs as an umbraculum. The glass slats are opened to permit ventilation at the same time that the high reflective curtain placed behind the slats avoids radiation from getting into either the newly created intermediate space or the inside one during the sunrise and the sunset. Blinds in front of the windows in the existing building permit lighting control while preserving some views due to its transparency.
5-N.ex.out

Improvement based on the creation of a perimeter buffer intermediate space acting as a greenhouse in winter and an umbraculum in summer.

System description

Exempt intervention
- Double glass practicable enclosure.

Intervention over the existing wall
- Movable thermal insulation panels over the inner side of the wall.
- Light control blinds in front of the windows.
- Thermal insulated shutter behind the windows.

Behaviour
- Cold season
  During cold season, the new glass enclosure performs as a greenhouse improving the thermal conditions in the inside of the ancient construction by decreasing the temperature difference between the two sides of its walls. However, thermally insulating those existing walls is needed so as
to grant comfort conditions when sun radiation is not enough. This thermal insulation is placed in the inside of the existing wall so as to keep seen the ancient building from the new intermediate space created. It is formed by movable panels so as to permit benefit the inside space of the thermal inertia of the wall just by opening them, or creating a nearly continuous thermal insulated enclosure when being closed.

- Hot season

During the hot season, the new construction performs as an umbraculum. The glass panes are opened to permit ventilation. Blinds in front of the windows in the existing building permit lighting control while preserving some views due to its transparency.