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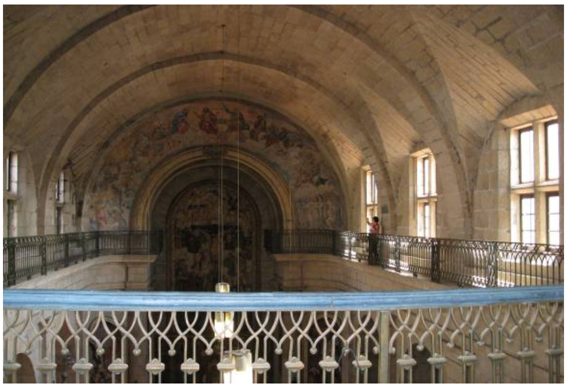
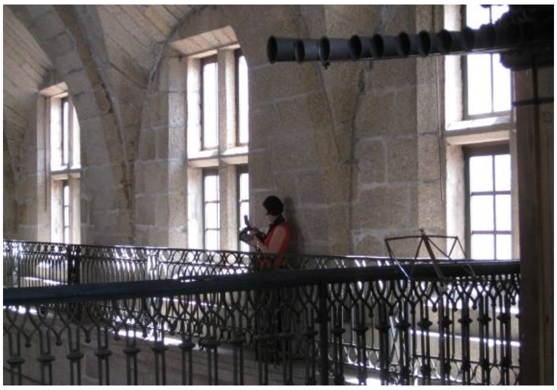
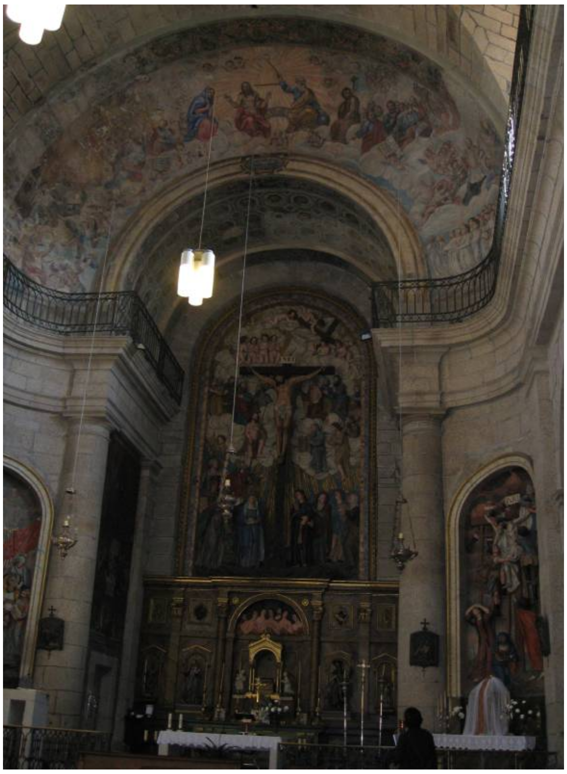
Capela Xeral das Ánimas, Santiago de Compostela

Photo gallery

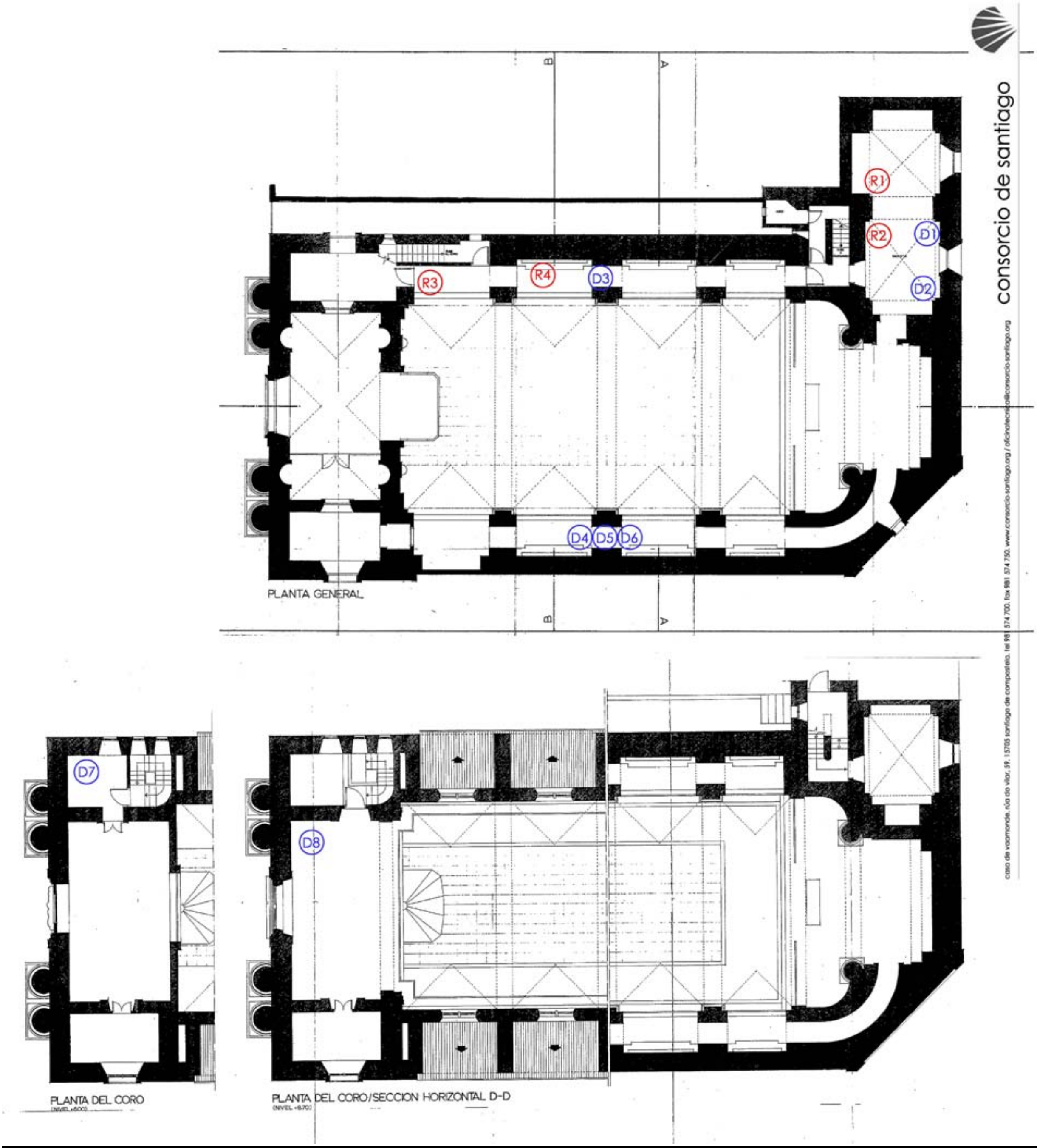


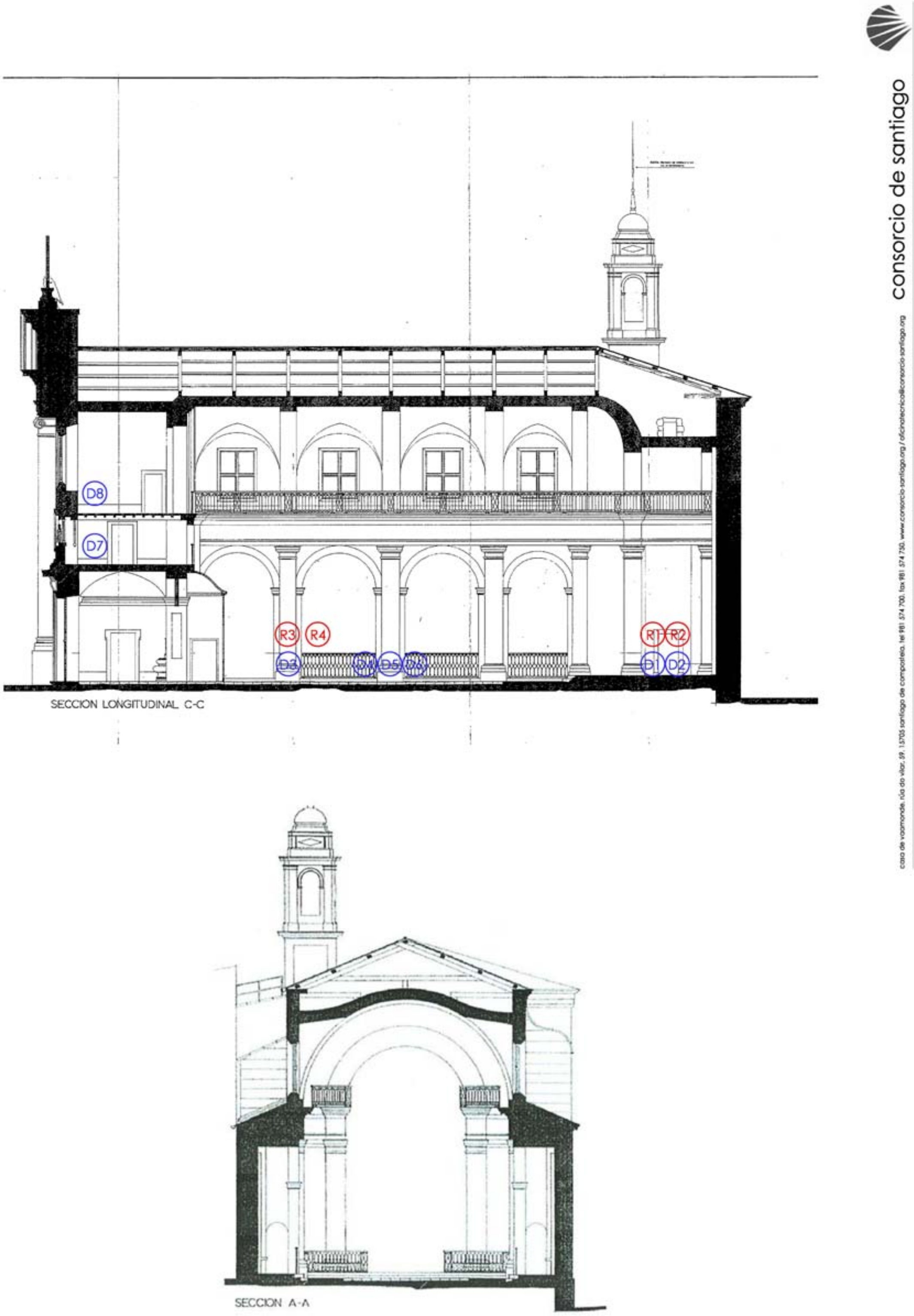




Plans and sections



Source: Consorcio de Santiago



Source: Consorcio de Santiago

Problems detected in the building

The church counts with the presence of 9 altarpieces in an advanced deterioration state, especially in the Western side.

Main cause of deterioration is humidity that for different reasons is accumulated in the back part to the Western wall, whose exterior is characterized by an alley that has considerable lacks in the water evacuation system and which causes migrations of humidity from the exterior to the interior of the chapel.

The temperature differential favours humidity transfer to the interior, transporting soluble salts. The humidity and salts presence cause variations of volume in the plaster which causes the fall of the polychromes and of the stucco's layers.

Possible deterioration causes that have been observed in the Chapel are:

- *HUMIDITY*
  - ✓ Filtrations. It has had filtrations of humidity from the roof in the past, most notably in the Western side, and especially in the second chapel. In principle those filtrations have been rein in with the rehabilitation of the cover.
  - ✓ Humidity for capillarity. Upward humidity in the Western area, as the ground has the same height of the exterior. This does not happen in the Eastern side, where the ground in the exterior is lower than in the interior of the temple. The presence of the alley in the exterior of the Western side is an important focus of humidity towards the chapel, as the presence of edifications in the surrounding area.
- DIRECT SUNLIGHT. Rays of the sun stress directly on the polychromes of altarpieces at certain hours of the day. This occurs in a different way in every altarpiece, due to the orientation of the chapel.
- NATURAL DIRT AND AGING OF THE POLYCHROMES

From an energetic point of view, the Capilla de las Ánimas church, does not have the problematic that other types of buildings or houses may have. It does not have relevant energy expenditure in relation to its volume, although the main energy saving measures would go through a strict management of the daily opening and closing of doors and windows.

The church has no significant structural damages. The most important damages are the humidities and the diseases they cause. The way to avoid further damages in any of the parts of the church is to control these humidities, and specifically to eliminate the causes of them.

Main building's characteristics and actual systems provided

Total floor space: 627,50 m^2

Average storeys: 3

Main building construction: stone, regular ashlars

Main uses: place of worship

Main fuel used for space heating: The building doesn't have heating installations but counts with 3 oil electric radiators (between 1500 and 2000W), a warm air transmitter for the confessional and 8 dehumidifiers in continuous working both in summer and winter for the 24hours/day. Five of them have a power of 440W and 3 of them 320W, using between 50 and 60 litres of water per day.

Main fuel used for hot water: hot water not provided

Renewable installation: not installed

Energy consumption: 1500-2000 kwh (bi-monthly consumption)

Goal, criteria and proposed alternatives

The multicriteria tool for the evaluation of the compatibility of energetic projects in historical buildings, developed in the SECHURBA project is based on the Super Decision software, based on the network analytical process of Thomas Saaty.

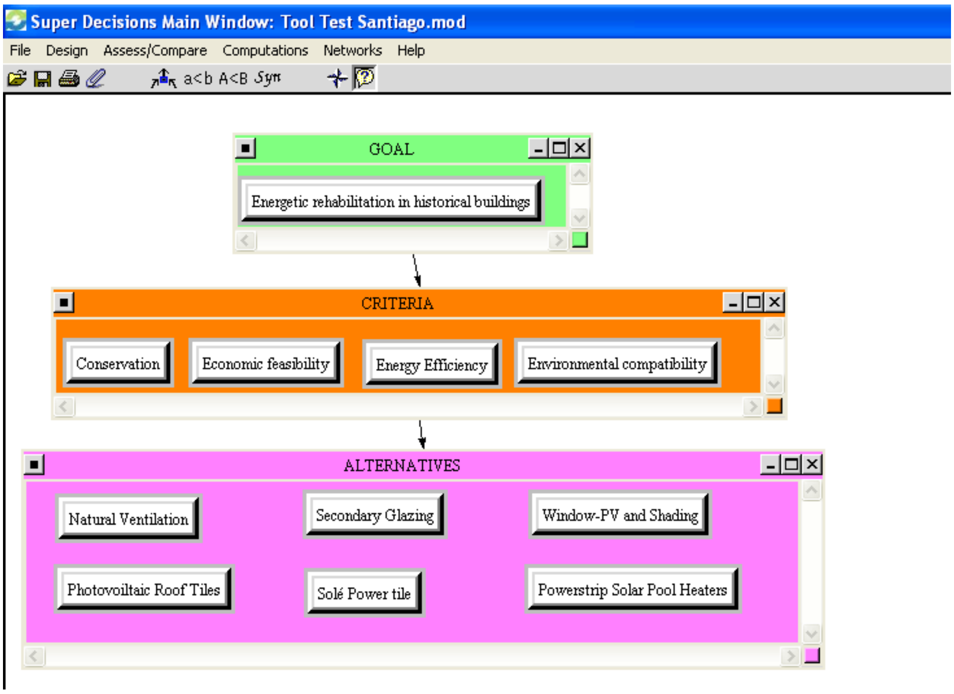
Starting from the point that main objective (goal) for which the tool has been developed, is to evaluate different solutions for the energetic rehabilitation in historical buildings and following criteria established by ITABC, different alternatives have been chosen after a study of the building and the analysis of possible interventions.

An expert group formed by members of the Consorcio of Santiago and Labein-Tecnalia compared the 4 criteria in order to establish priorities between them. For the tool evaluation two meetings have been carried on: one in Santiago de Compostela in May 2010 and the second one in Labein's offices in June 2010, in order to discuss about possible improvements of the tool.

Once established the hierarchical structure of the criteria, each selected alternative was compared for each criterion.

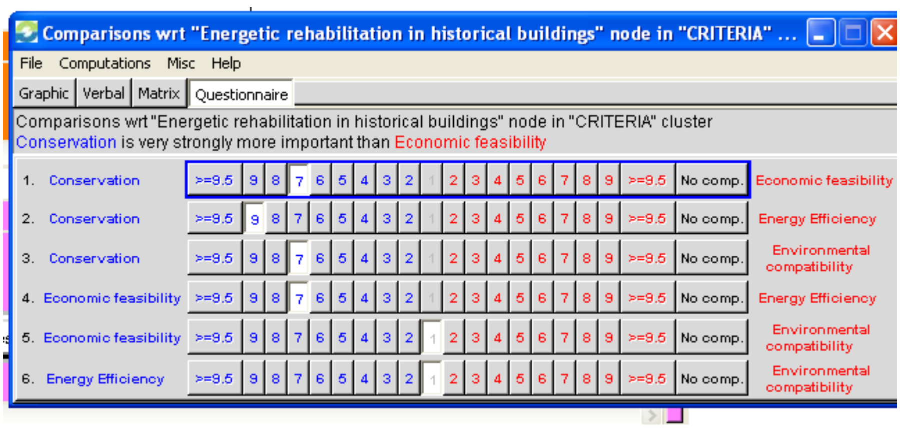
In the study case of Santiago, 6 alternatives were chosen. As described before and as reported in the energy audit, main problem of the building is the presence of humidity which causes problems not only to people who enters and stay for a quite long time in the church but also to the works of art installed inside the building. Three of these alternatives have been chosen in order to solve problem of water filtration by improving the roof structure and substitute the small amount of energy requested in the building. The other three alternatives are less invasive and have been chosen in order to improve ventilation and help scatter of humidity or façade elements, as windows, in order to improve insulation.

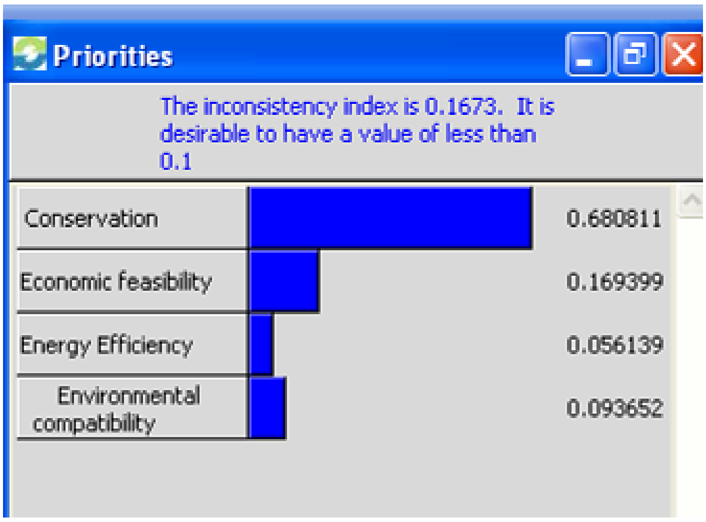
Evaluation model



Priorities between criteria

First step was assigning priorities to the criteria established. The expert team gave more importance to the conservation criterion respect all the other criteria. Santiago is declared as a World Heritage Site and conservation is the fundamental for the preservation its historical city. Expert team also judged that environment compatibility is equally important as economic feasibility and energy efficiency and that economic feasibility is more important than energy efficiency. The judgement is in line with the Consorcio philosophy which is based on small conservation interventions aimed at meeting a large part of citizens' requests in order to motivate people living in the historical centre.





Priorities between criteria and alternatives

The expert team evaluated the different alternatives in a collaborative session, as it was considered that a discussion between technicians was more useful in order to reach the best solution alternative for everyone and it permits having a general and shared vision of the different perspectives.

As described before 6 alternatives have been selected:

Natural Ventilation

One of the problems that the church should focus is ventilation, which might affect the works of art conserved in the building. Problems of stagnate humidity which justifies presence of dehumidifiers might be solved by improving natural air flow and the correct ventilation procedure. Main barrier of this solution is that the building is used only partially during the day and annual rainy rate is high. For this reason natural ventilation should be combined with at least another system, as for example secondary glazing. As the church is located in a pedestrian zone and there are no problems of pollution or traffic noise, the use of both systems will guarantee the necessary air flow without permitting entrance of rain.

Secondary Glazing

This solution has been applied in different interventions of the historical centre of Santiago. Because of the climate, rainy and cold in winter, secondary glazing are used to reduce heat loss where the substitution of the window is not admitted. It works by creating a barrier of air between the two windows. To reach its optimal characteristic it should always consider ventilation issues in order not to obtain a sealed microenvironment. Secondary glazing combined with natural ventilation and automatic systems which permits opening and closing of windows could be a suitable solution in order to solve humidity problems.

Window-PV and Shading

This system provides a good solution for the conservation point of view, as it is reversible, compatible with old materials and follows the minimum intervention criterion. The problem of its application in the church of Santiago is that windows only have one glazing pan but it would be useful for protection of the stuccos damaged by the direct sunlight entering from the windows.

Photovoltaic Roof Tile

This technology is formed by tiles containing photovoltaic cells which transform solar energy into electricity. Also if this system from an energy efficiency point of view is better than previous solution, this technology is still expensive, as its installation have to be done manually, tile by tile and costs have to be justified as the surface used smaller and consequently energy production lower that traditional systems. Also if for the Santiago case study, these tiles have are too expensive for the possible return, it’s a good solution for historical buildings, where integration of traditional PV is not allowed.

Solé Power Tile

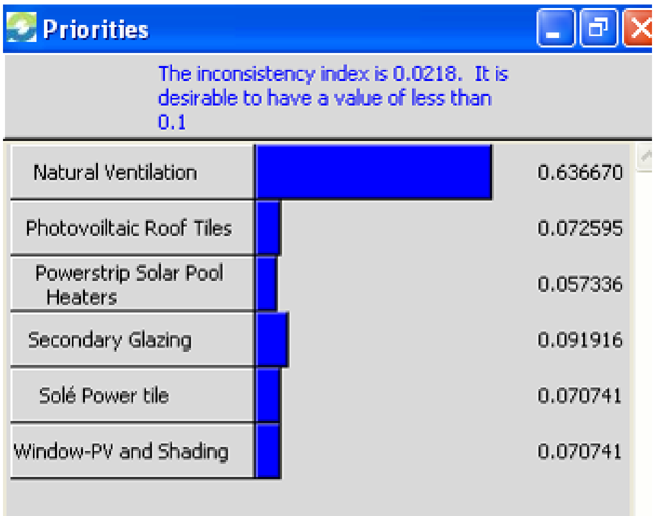
This solution is usually used where solar panels are not allowed by local regulations. The tiles integrate seamlessly with clay tile roofs, making it easy to upgrade a curved tile roof to a power generating platform. As the previous technology, this system is too expensive for the Santiago de Compostela case study, as the building doesn’t have very high energy consumption, due to the nature of its function.

Powerstrip Solar Pool

This technology consists in solar collectors made of polypropylene. There are many solar pool heating collector panel styles available. They break down into major categories, flexible and rigid. This product can be glued horizontally to tile roofs as tiles are wavy and the Powerstrip can follow the waves. As the previous roof technologies presented main barrier is that no changes in outdoor and indoor appearance can be allowed because of the level of protection of the church.

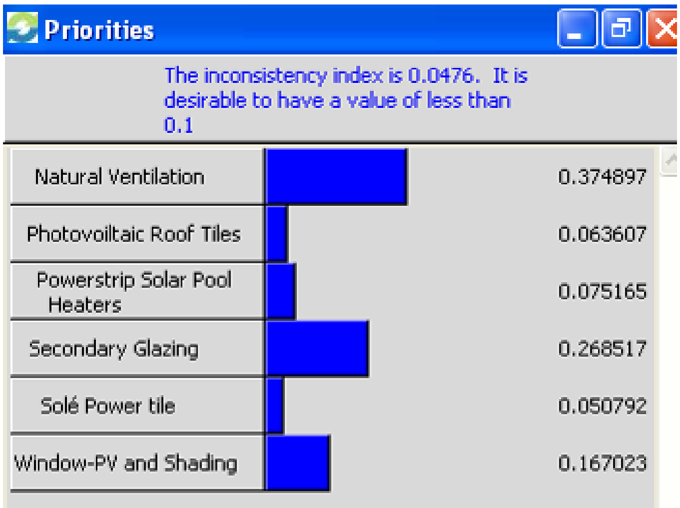
1. Conservation

Conservation criterion was defined as assessment of the impact of the proposed interventions in the light of the international conventions of conservation (Restoration Charts). Proposed alternatives were analysed following main concepts of compatibility between new and old material; minimum intervention; reversibility; sustainability and legibility of new works. As expected, natural ventilation is the favourite system for this criterion with a high difference in the evaluation, as the impact of this intervention is almost none, followed by secondary glazing and photovoltaic roof tile. This last one with a small difference of punctuation with respect to the others analysed.



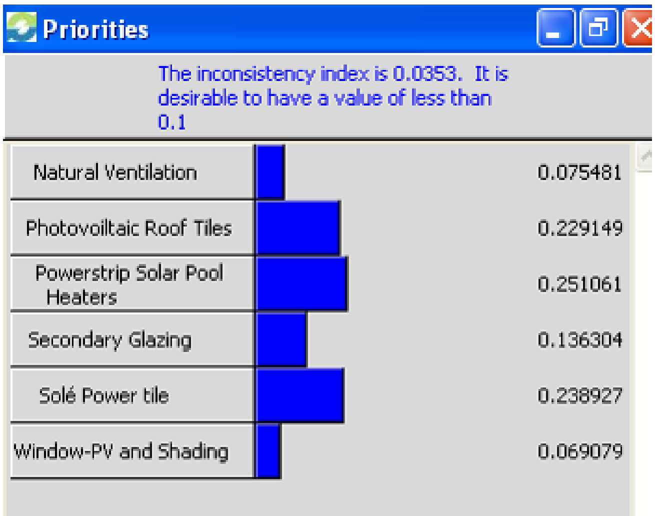
2. Economic feasibility

By assessing economic budgetary feasibility costs, amortizable time and low consumption have been taken into account. Also in this case, technologies that don't present a high initial inversion have been awarded. In the case study of Santiago a roof intervention will suppose an expensive capital expenditure which will give benefits in a large period.



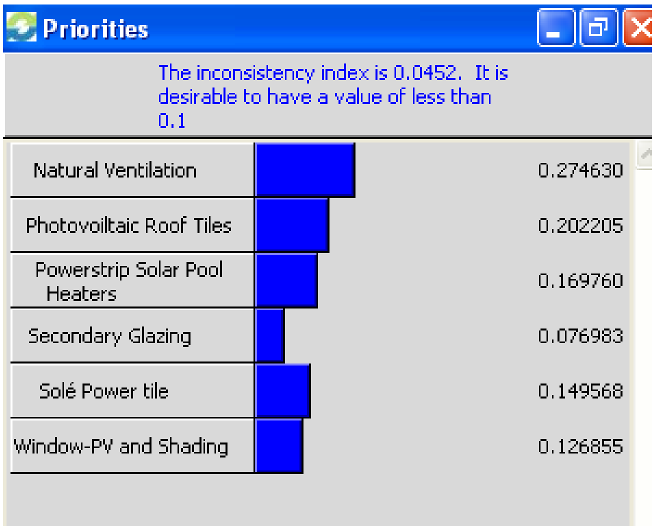
3. Energy efficiency

Assessment of energy efficiency includes improving building/plant energy efficiency and low energy consumption. Following this criterion it is clear that we have a reverse situation: systems with a very low impact on building and with a very low cost are less energy efficient. In order to improve energy efficiency in a building the owner of the building has to be ready to invest money on new technologies. The payback of these technologies is much more convenient, as energy consumption decreases.



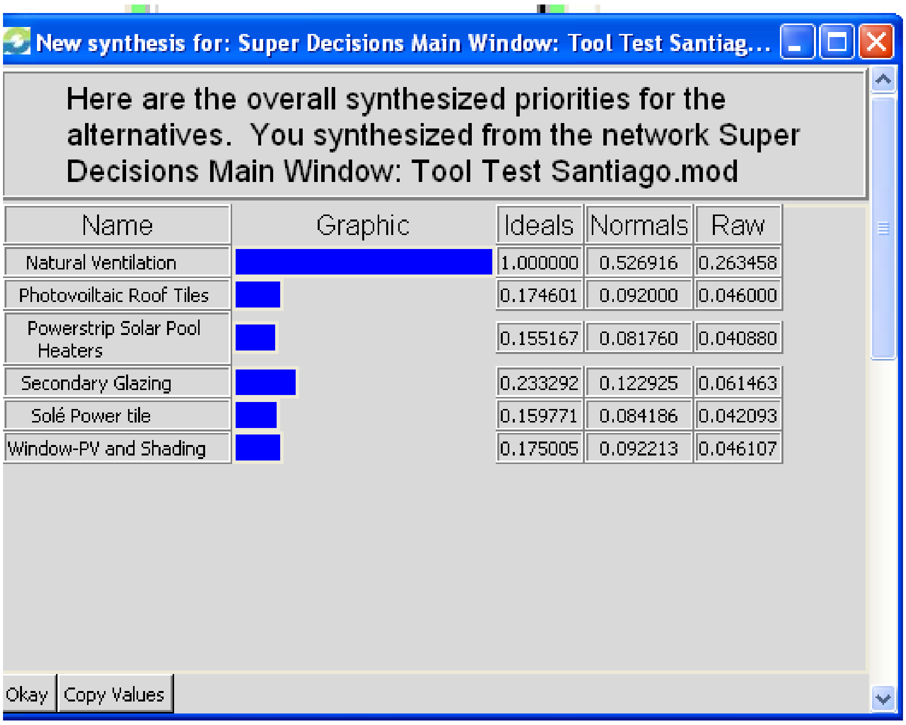
4. Environmental compatibility

In the assessment of the environmental compatibility two main concepts were included: minimization of environmental pollution and the use of renewable sources. This evaluation was quite difficult as, if we think about systems as natural ventilation which, considering only these twos aspects would have a low value. Natural ventilation was instead the system which received the highest priority as there is no need of producing new technologies and its impact on the environment is null. It is true that this system doesn't contribute to reduce pollution and doesn't use renewable but it's perfectly compatible with the environment.



Results

The graph below shows final evaluation of the proposed alternatives. Natural ventilation is the most suitable solution in terms of cost, conservation principles and environmental compatibility. The use of natural ventilation in Santiago will help to reduce humidity and preserve works of art. It needs to be implemented with other systems as secondary glazing and shading systems in order to obtain maximum benefit. This intervention will permit decrease use of dehumidifiers which are now working 24 hours a day.



New synthesis for: Super Decisions Main Window: Tool Test Santiag...

Here are the overall synthesized priorities for the alternatives. You synthesized from the network Super Decisions Main Window: Tool Test Santiago.mod

Name	Graphic	Ideals	Normals	Raw
Natural Ventilation		1.000000	0.526916	0.263458
Photovoiltaic Roof Tiles		0.174601	0.092000	0.046000
Powerstrip Solar Pool Heaters		0.155167	0.081760	0.040880
Secondary Glazing		0.233292	0.122925	0.061463
Solé Power tile		0.159771	0.084186	0.042093
Window-PV and Shading		0.175005	0.092213	0.046107

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Comments to the tool use

This section gather together the conclusions of the second meeting carried on in Labein with the experts of the Consorcio de Santiago and aims at considering and criticise the utility of the tool by end users.

The tool developed under the SECHURBA project and the selected parameters might be used to work on a global and strategic scale, or on a master plan level, as a first phase of approximation in which the demand is to achieve initial conclusions that have to be filtrated, pondered and interpreted. The tool has its main interest in the evaluation of global matters in which a heterogeneous group of technicians, experts and/or stakeholders are involved, but always as a starting point for a further deeper analysis.

However the tool doesn't seem to achieve a positive response in its use during the different phases of the rehabilitation process and urban recovery and- for extension field- in none of the phases linked to the building process.

It has been considered that the analytical process in which the tool is based is a comparative evaluation system which working plan- generic, theoretical and abstract- is left out from the real rehabilitation processes and urban recovery. The logical planning and execution has to meet and combine technical, social, economic and normative factors, characterized by a very different nature, which cannot be pondered on closed criteria and methodologies, neither for their number nor for their character.

Anyway the rehabilitation and recovery processes are dynamic and in many cases discontinues, for which the conclusions draw up by the tool would be adjusted to a specific situation with explicit parameters. These conclusions are invalidated if the parameters change.

Besides, the logical framework of the proposed tool (which aims at evaluating in a comparative way the elements according to the possible peers formed with the proposed factors) leads to subjective and poorly justified opinions and evaluations. This introduces multiple factors of doubt even though one of the objectives of the tool is the evaluation objectiveness.

Finally, the evaluation of the suitability of the technical solutions, products and materials should not be done by a tool but needs to be proposed and justified by documents during the project, as a result of an intense technical work adjusted to real and specific conditions. The use of this tool in relation to the rehabilitation process presents the risk of introducing inadequate solutions for their evaluation and decisions related to historical buildings need to be undertaken by a coordinated work of technicians, institutions, citizens, companies and professionals.