523: Sustainable architecture for horses

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Abstract

Located in Solis, 95km north of Buenos Aires, The Rehabilitation Centre for Horses is a building complex constructed on a site with some existing facilities of an old horse farm. Construction completed in august 2008. The total floor area is 10.000 m² in a 36ha site. The project is composed of 4 different sectors:

-Administration and Clinical Facilities (Recycled existing building)
-Educational and Library Building (Recycled existing building)
-Rehabilitation Centre (New building)
-Service and Accommodations building (New building)

The design has focused on user's comfort (people and horses), as well as on reducing energy consumption. The project has integrated scientific analysis from specialized environmental advisors and a holistic research of medical and practical issues in order to develop a new architectural expression.

The project shows several aspects of sustainable architecture in a new way, it presents a spatial modernization responsible for regarding the environment while at the same time it is sensitive to traditions without offending and ignoring local aspects. The respectful treatment to the existing buildings and its layout, guided the design process giving them a key place in the new site plan.

This paper presents two different aspects of a sustainable building.

On one hand it demonstrates how to meet comfort conditions for horses in two fundamental aspects of passive and low energy architecture: natural ventilation and lighting.

On the other hand, the paper focuses on the building's design as a promoter of environmental consciousness.

Keywords: Architectural expression
Natural ventilation
Maximizing daylight

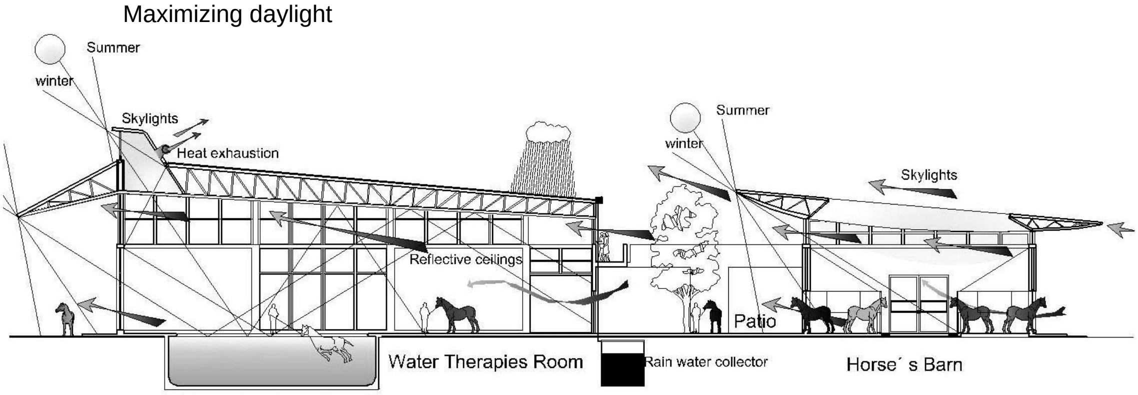

Fig 1: Rehabilitation Centre. Cross section.

1. Introduction

In the Rehabilitation Centre, human and horse's conditions for comfort are met with passive strategies based on innovative formal solutions.

The spatial quality presented in the main new building improves two fundamental aspects for horse accommodation and care; natural ventilation and lighting.

In addition this paper proposes architectural expression as another parameter to be considered in the environmental performance of a building.

Fig 2: Water therapies building. NE view.

2. Passive & Low Energy Architecture

2.1 Natural ventilation

The Rehabilitation Centre building is divided into two main sectors; the horse barn and the building for water therapy. Quality criteria of ventilation responded to the need of:

- Control of horse odours
- Control of humidity of the air provoked by evaporation from the swimming pool
- Control of heat in summer

The shape of the roof of the horse barn, inspired on aero-dynamical principles, helps to eliminate heat, dust, insects, and spider webs from the indoor space.
•The shape also allows optimal natural ventilation. It's shape helps to accelerate the wind passing through the building taking out inner heat faster.
•The convex inner shape also serves to keep ceilings clean and aseptic.

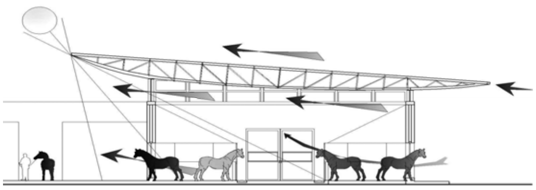

Fig 3: Wind induced ventilation

In the main space for water therapy, it is recommended that natural ventilation is 10 renovations of air per hour, considering a volume of 16.000 m^3 and a height of 7 metres.
50 % of the windows can be opened, totalling an open area of 200 $m^{2.}$
Additionally, doors on SE, NE y NW façades duplicate this area when opened. During cold days it is possible to have the entire building closed. Calculations for wind induced ventilation indicate that natural ventilation is adequate with 50% of upper windows opened. In less favourable climatic conditions: very low wind (3-4 km/hr at 10m height), ventilation by difference of altitude and temperature with a difference of 3º C between inside and outside, estimating > 10 renovations of air per hour it's adequate for each spatial ventilation.

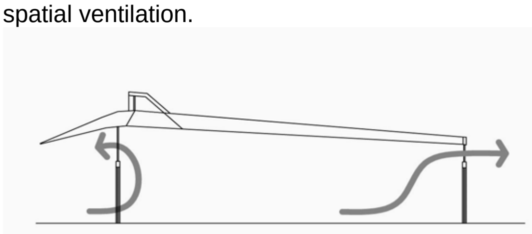

Fig 4: Ventilation by difference of altitude and temperature

On calm days, with accumulation of odours, water steam, and heat it is recommended to incorporate industrial fans to reach a minimum ventilation of 5 to 10 renovations of air per hour, especially in central zone. Forced ventilation requires at least 4 extractors of 1 HP and 70 cm diameter that move 30.000 m3/hour each.

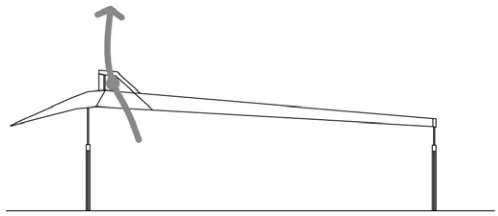

Fig 5: Forced ventilation

It has verified an adequate input and output of air for NE and SW winds. In the case of side winds, from N, S, E or W, higher openings allow a slightly minor input and output of natural ventilation if compared to NE and SW winds, however it is still adequate for good renovation of air. With NW and SE winds, higher openings allow a proper extraction of air due to their location in a low-pressure zone.

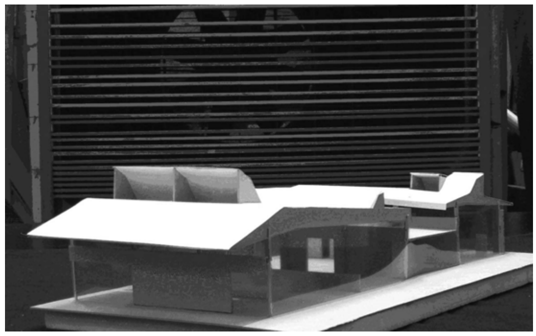

Fig 6: Wind tunnel and model

In order to analyze air movement in different situations, a model 1:100 was used in the wind tunnel.

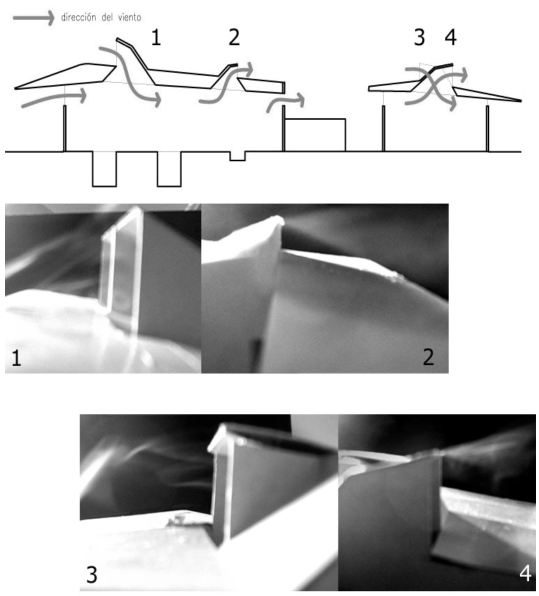

Fig 7: Wind tunnel tests

During design process some things were changed in order to avoid construction and operational problems. All changes were discussed and approved by consultants from the Environmental Laboratory of the University of Buenos Aires[1] . Final shape of barn roof was not tested in the wind tunnel but consultants agreed that those modifications will not affect it functionality.

2.2 Natural lighting

It was recommended that a minimum level of illumination for cloudy days is 300 lux for the activity required. Tests were done via a virtual model. The software used was Desktop Radiance 2.

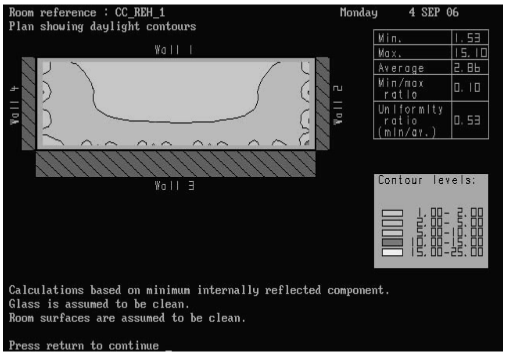

Fig 8: Virtual modelling of building without skylights

Radiance testing helped to measure the amount of light needed and the size of the skylights, it location changed during design process in order to avoid problems with rain water filtrations. Tests demonstrate that skylights are needed in the water therapy building in order to have adequate levels of natural lighting.

Fig 9: Virtual modelling showing inner space and skylights

Four skylights are proposed for the main space for the water therapy building in order to improve light distribution so as to increase the levels of natural lighting. Skylights allow a transmission of light of 80–85 %. The location of the skylights on top of the roof responds to the need of continuity on the roof and helps to eliminate the possibility of water filtrations.

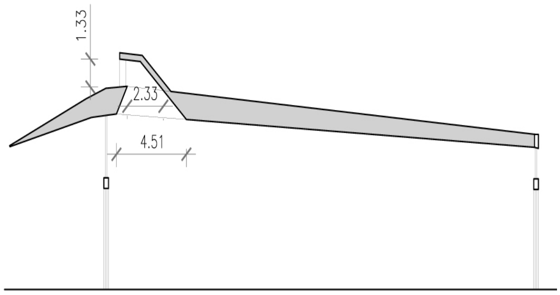

Fig 10: Location of skylights

In terms of the solar protection, tests were done to calculate radiation coming in during winter, equinox and summer. For that we use a 1:100 model in the Heliodon, simulator of the sun movement. Results indicated a reduced input of solar radiation in summer, avoiding the risk of overheating during the hotter seasons.

Fig 11: Water therapies building under construction. NE façade and skylights.

There are no radiation inputs through the roof during 12:00 to 4:00 pm. In summer, sun comes in through the NE façade from sunrise to 11:00 am.
The final design test with the heliodon helped to check that no aggressive sun rays affect the interiors of the building. For example, W, NW and SW façades have minimum openings.

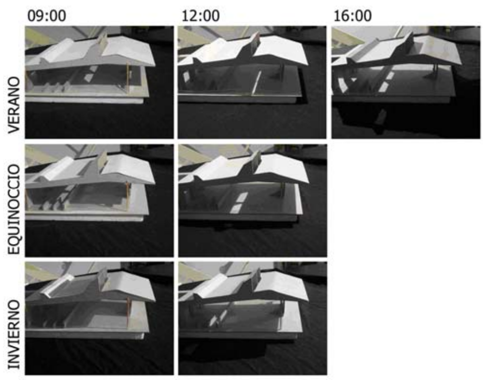

Fig 12: Solar protection test in the Heliodon

The tests done with virtual modelling show good levels of interior illumination and the reflective ceilings guarantee an adequate distribution of light. The centre has an optimised artificial lighting system with daylight sensors and low consumption lamps. It is important to note that during the day it is not necessary to use electric light.

Design process and testing were done hand by hand with the consultants, and every aspect was discussed together. However, and due to my background [2], many environmental aspects of the project were already incorporated when presented to the consultants.
A great synergy was created among the team, and all aspects were discussed and agreed before presented to the clients.
All tests were helpful to show the client why we have chosen those shapes, and to confirm that we were in the right way.
Now the building finished, it is encouraging to see that natural lighting and ventilation are a fact. It is real that no electrical light is needed during the day and cross ventilation really works.

Other issues proposed in the project are:
-Recycling of existing buildings.
-Recycling of existing materials found in site. All stall doors were made of wood found on-site, part of an existing fence of the original farm.
-Environmental Impact Analysis.
-Environmental Action Plan for construction.
-Opened to Community discussion.
-Solar energy for heating water.
-Building surfaces with minimum glass surface to sun exposure.
-Rain Water collection.
-Waste management.

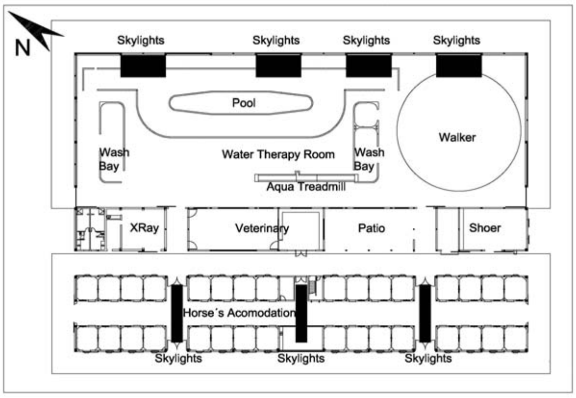

Fig 13: Rehabilitation Centre Building. Skylights location

3. Architectural Expression

3.1 Horse’s accommodation background

In terms of background research, no literature on sustainable horse barns exists, just some books about traditional horse barns that have only helped to understood functional aspects of horse accommodation.
Because the horses spend 22 hours daily in the stalls and 2 hours at therapy, their comfort is crucial.
The animals can suffer respiratory diseases produced by flying particles of dust that are found in the interior of the barn. Heat and humidity are also enemies for horses. If traditional barns with the inverted V roof shape maintain contaminated air and particles in the interior, this project aims to avoid this through the design of an aero-dynamical roof.
Another aspect taken into account for horses’ comfort is their need to socialize with other horses; therefore we have designed the rooms in the barn with openings on all 4 sides. The view at eye level is wide open for the horses, almost 300 degrees.

Fig 14: Traditional barn.

3.2 A New Shape

In the book “Taking Shape”, Susannah Hagan [3] concludes on how important is “*to champion formal exploration and expression as allies of environmental design, not decadent obstacles, and to make room for aesthetics as well as ethics in the wide embrace of environmentalism.”*
The horse’s need for a clean inner space and the implementation of passive techniques for natural ventilation are represented in a new architectural expression. A sustainable approach to this kind of programme is pioneer in Argentina; therefore Kawell becomes a turning point in rural architecture. It is important to say that rural and especially equestrian market in Argentina is a very traditional one, where the input of a new vision it is a very difficult task.
Because the owners of Kawell are foreigners (from Switzerland) it was an issue for them to incorporate environmental strategies in order to come out with a totally new building.
It is also a new approach to horse care to think on rehabilitation. People in Argentina are not use to it; they normally discard them sending injured horse to the farm.
If we look around rural buildings in Argentina, we will only find traditional architecture without environmental aspects in it.

Fig 15: Horse´s barn in terior

4. Conclusion

Within a utilitarian context, the environmental performance of a project is measured by quantifying fossil fuel consumption encompassing construction as well as operation. This statement excludes the contribution aesthetics can make to environmental ethics pushing architectural expression to a secondary issue.

As Susannah Hagan says [4] "…*it matters how buildings are built and run, and it matters that environmentalism's view of the world is adopted by all the participants in the building industry, architects included, as soon as possible. Environmental architecture that inspires and excites has therefore as much of a role to play as that which performs virtuously, because the effect of the former is disproportionately large in relation to its numbers. We cannot afford to dismiss the contribution aesthetics can make to environmental ethics at this point in the development of environmental architecture.* "

The Rehabilitation Centre for Horses acts in response to Hagan's enquiry, as it gives to its formal expression the similar degree of importance given to it environmental performance.

Based on environmental principles the project for the Rehabilitation Centre for Horses is an interesting case study and it helps to show the community how to implement these practices.

Focus on aesthetics can and does make a contribution to environmental ethics.

Fig 16: Horse's Barn SW view.

5. References

1. CIHE. Centro de Investigación del Hábitat y la Energía, directed by Dr. John Martin Evans and Dr. Silvia de Schiller

2. Master of Arts at the Architectural Association of London (1998) focused on sustainability and a 2 years practice experience in Brazil working in association to environmental architect Rodrigo Mindlin Loeb.

3. Hagan, Susannah, (2001). *Taking Shape. A New Contract between Architecture and Nature*, p. 193.

4. Hagan, Susannah, (2001). *Taking Shape. A New Contract between Architecture and Nature*, p. 193.

Photographs of the building taken on June 12th 2008