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TIMBER STRUCTURES IN THE NEW *CERRADO'S* INFORMATION CENTRE AT THE BRASÍLIA BOTANICAL GARDEN – BRAZIL

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ABSTRACT: The use of eucalyptus wood in the building site is intensifying in Brazil, consolidating it as an alternative to the native tropical wood. Nowadays, planted forests occupy only 0.6% of Brazilian territory and supply about 85% of all forest-based products found in the market. Pinus and eucalyptus are the main fast-growth species that occur in our country. The structural performance and linearity of the rounded pieces result in a crescent use of eucalyptus treated wood, especially in rural constructions and fences, as well as in country houses and high standard beach houses and hotels. Besides that, the market of treated wood is becoming more and more attractive, due to its profitability.

Based on several buildings designed and built with timber structures, it was proposed the new *Cerrado's* Information Centre, to be implanted at the visitor's area of the Brasília Botanical Garden, in Brazil's federal capital. The building was designed according to bioclimatic guidelines, as natural ventilation and illumination, thermal inertia, green covering and protection of the facades. The building was conceived in a spiral shape and different levels, based on the design of local bird's nest. The frame of eucalyptus logs was conceived as porticos with double masonries and concrete walls and with a rounded shape in the central area of the building, with 12,00m-high and two levels in the roofing. This article presents the design of this building, showing the several constructive possibilities of using rounded eucalyptus structures.

KEYWORDS: Wood, Timber structures, Sustainable building

1 INTRODUCTION

Progressively the eucalyptus wood is becoming an alternative to the tropical hardwood in our country, where it's used mainly in the furniture industry. It is also found in rural constructions as well as in country houses and in high standard beach houses, where the pressure-treated rounded wood is largely used.

Its use in the rounded shape results in a cost-effective application of the material, besides providing an economical form of construction. Among the disadvantages, the difficulty in the execution of connections is the most important, being usually used traditional solutions that don't explore the qualities of the material.

Starting from the experience of previous works executed with the structural use of the rounded eucalyptus wood, it was proposed the new *Cerrado's* Information Centre, to be implanted at the visitor's area of the Brasília Botanical Garden, in Brazil's federal capital. The Brasília Botanical Garden is one of the world's largest botanical gardens, with a representative area of the original *cerrado* ecosystem that surrounded the city 50 years ago.

2 METHODOLOGY

The design of the *Cerrado's* Information Centre was conceived based in the following premises:

- To be designed according to bioclimatic guidelines, in order to be fully adapted to local climate, with some requirements as natural ventilation and illumination, thermal inertia, green covering and protection against sunlight in the facades, aiming to build a "sustainable building";
- To be in consonance with the existing facilities (made of timber structures) and to harmonize with the surrounding environment;
- To propose mixed building solutions between traditional concrete structures and timber structures, aiming to promote "greenest materials";
- To show the required integration between structure and architecture in wooden buildings;
- And finally to highlight the imposing architectural aesthetics that comes from the presence of timber structures in natural areas.

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3 DESCRIPTION OF THE PROJECT

3.1 DESIGN GUIDELINES

Based on the design of local bird's nest, the building was conceived in a spiral shape, which allows the visitors to be able to see both internal and external spaces at the same time. Figures 1 and 2 show external views of the building's model.

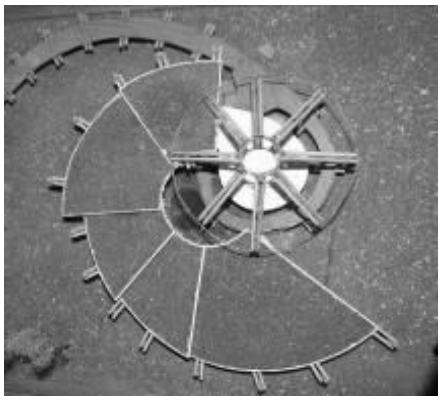

Figure 1: *External view of the building model*

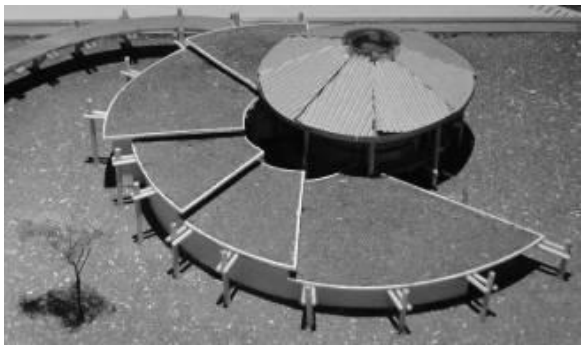

Figure 2: *External view of the building's model*

The building was designed according to bioclimatic guidelines, in order to be fully adapted to local climate. Some requirements as natural ventilation and illumination, thermal inertia, green covering and protection against sunlight in the facades were added to the architectural design, aiming to build a "sustainable building". As illustrated in Figure 3, the natural ventilation mixed to the surface water inside the building will result in an evaporative cooling of the area.

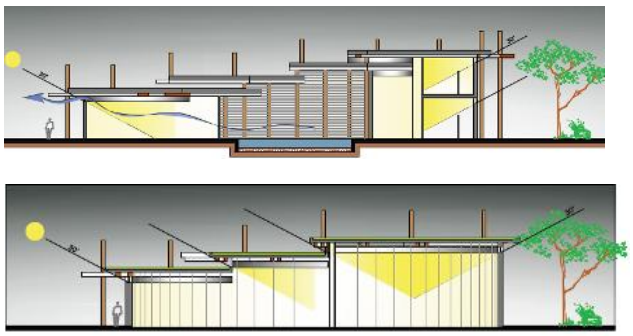

Figure 3: *Cross sections of the building showing bioclimatic strategies*

Figure 4 show the floor plan of the *Cerrado's* Information Centre, where it's organic shape creates an inspiring circuit to the visitors and the natural light becomes diffuse because of the reflecting pool.

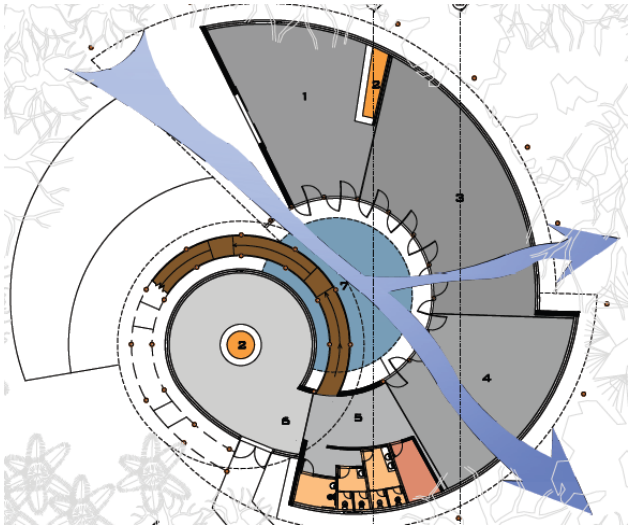

Figure 4: *Floor plan of the* Cerrado's *Information Centre*

The central area of the building is destined to a living area that leads out of the building. Continuing the circuit, the ramp rises up and comes to the mezzanine, and later to a pedestrian walkway that leads to the observation deck, where the surrounding natural vegetation (*cerrado*) can be contemplated.

The green covering has different levels that allow a diffuse natural light go inside the building, creating an inspiring atmosphere which enriches the exhibition areas. Figure 5 show the first floor of the building, where a surrounding ramp links the different levels of the central area and the green covering can be viewed.

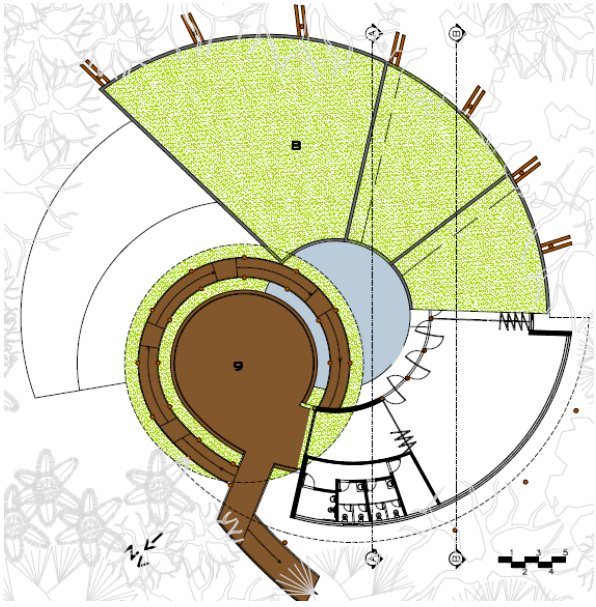

Figure 5: *Plan of the first floor*

The proposal of the green covering is aligned to the main guideline of this building: to be as “greener” as possible. This solution contributes to a better thermal performance because of its thermal inertia. Besides that, the green covering helps in the increasing of the humidity of the area. The covering plan can de viewed in Figure 6.

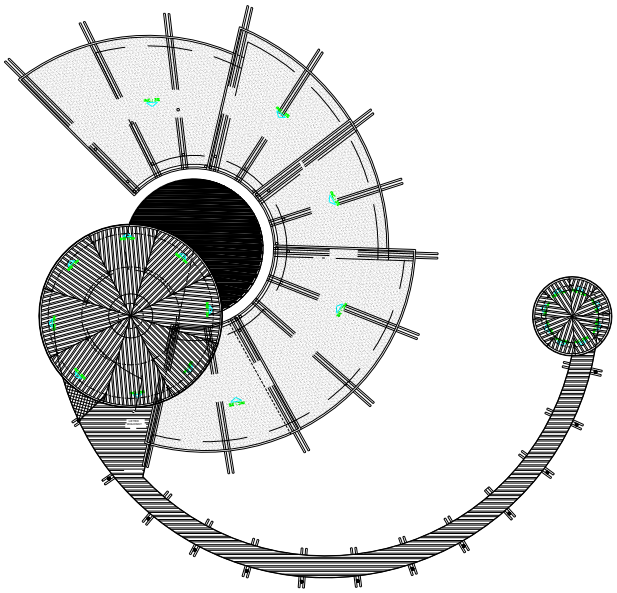

Figure 6: *Plan of the covering*

Complementing the covering design, it was established the use of rainwater for non-potable use, where the collected water from the roof will be filtered and placed in tanks. After that, a pumping system will distribute the water for non-potable utilization in general.

The thermal inertia will be reinforced by the use of soil cement bricks in double walls that will be installed in all the perimeter of the building. Figure 7 shows two facades of the building.

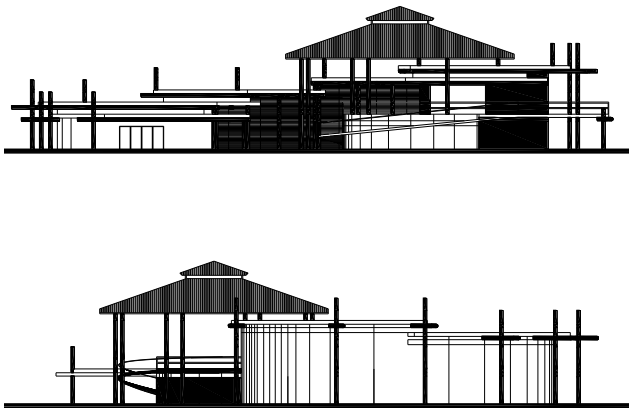

Figure 7: *Facades of the* Cerrado’s *Information Centre*

The use of wood in the building is essential to make it “greener”, because wood is the only renewable construction material and no other material has its environmental performance. According to the concept of "green buildings" established in the countries of Europe and North America, and programs for evaluating the performance of materials such as LCA and LEED, wood is considered more environmentally correct.

The structural and constructive use of wood in Brazil is still very limited, with a massive presence of buildings made of reinforced concrete and steel. Although the country is the largest producer and consumer of tropical timber in the world, this is intended primarily for secondary uses such as braces, roof structure, window frames and furniture.

Factors such as the Portuguese colonization, based on the intensive use of sand and stone as well as government policies that favoured the cement and steel industries, contributed to our building tradition and the lack of knowledge by the population in relation to wooden buildings.

Despite the illegal practices that still characterize the forest sector of our country, the forestal activity represents one of the great possibilities of maintaining our forest resources, because the timber market needs the forest. The statistics confirm that the agricultural and cattle activities are largely responsible for the observed rate in the Amazon deforestation.

In this context, adding value to forest products, such as timber, means providing an economic viability to the owner, which will force him to keep the forest standing. There is no contradiction, therefore, to say that logging is one of the few options to keep the forest especially in the Amazon region, where the natural regeneration of tropical forests means that with sustainable forest management techniques, it’s possible to have high productivity with low impact without requiring the planting of one tree seedling.

The building of the *Cerrado’s* Information Centre will contribute to add value to our forest based products, and that includes the structural use of fast-growth species like eucalyptus.

The structural performance and linearity of the rounded pieces result in a crescent use of eucalyptus treated wood, especially in rural constructions and fences, as well as in country houses and high standard beach houses and hotels. Besides that, the market of treated wood is becoming more and more attractive, due to its profitability.

While we are implementing several policies related to the complete legalization of logging in our country, eucalyptus wood has become a strategic alternative to the use of Amazon timber in construction.

3.2 STRUCTURAL CONCEPTION

The frame of eucalyptus logs was mixed to concrete structures and masonries, creating an inspiring skeleton for this building. Conceived as rounded wood porticos, the timber structures receive a rounded shape in the central area of the building. Due to the circular shape of the coverage, glulam pieces were used at the edges of the covering structure and also supporting the ramp. Figures 8 and 9 show the structural design of the building.

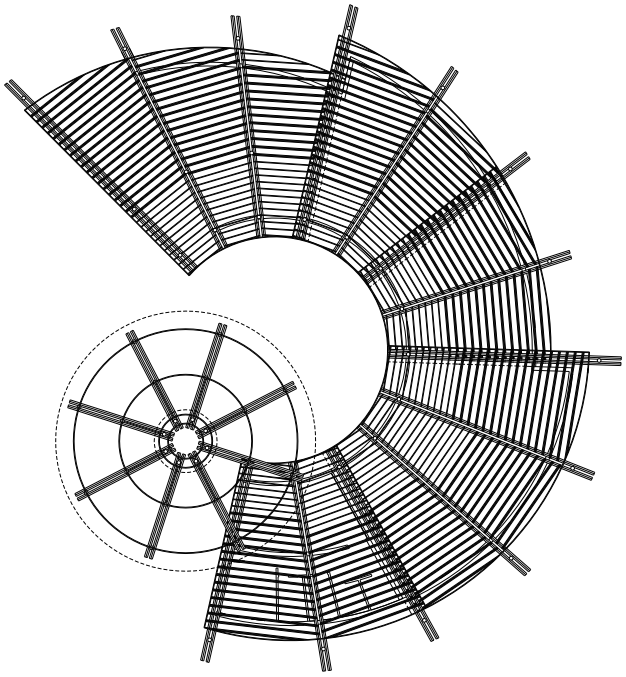

Figure 8: *Structural plan of the covering level*

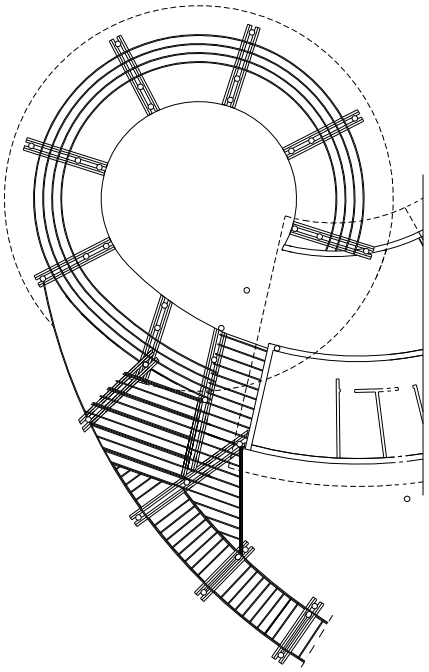

Figure 9: *Structural plan of the flooring level of the central area and the ramp*

The porticos are disposed in different levels, creating a sequence of unusual exposition areas that leads the visitors to the central area of the building. Figure 10 shows examples of different round wood porticos.

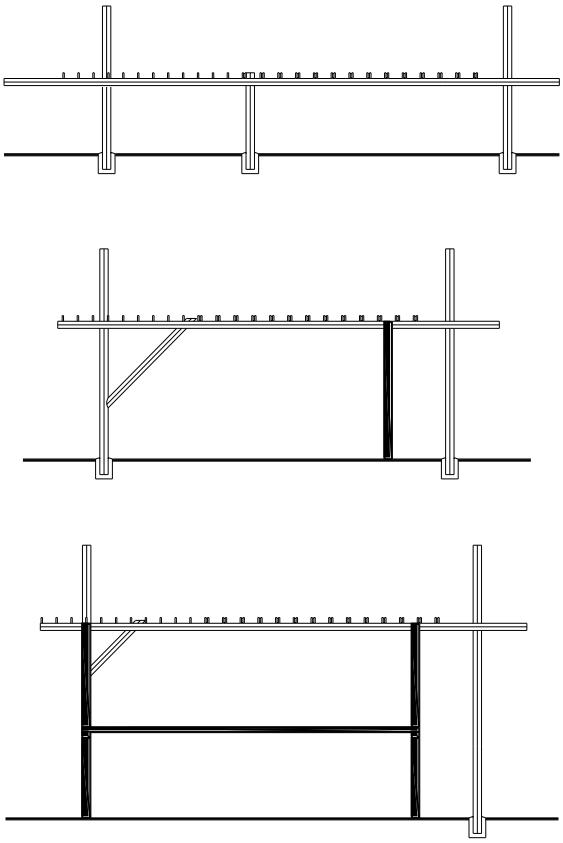

Figure 10: *Examples of round wood porticos*

The frames are composed of single pillars that receive double beams in bolted connections. These eucalyptus frames supports the flooring structure made of Tuturubá (*Pouteria oblanceolata*), an Amazonian lesser-known specie that is more and more available in our local market. Figure 11 show a detail of the joint between the pillar and the double beams.

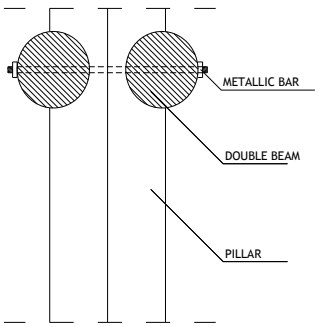

Figure 11: *Detail of the joint between the pillar and the double beams*

The sequence of frames culminates in a central area in a circular shape, with 12.00 m height and two levels of roofing. Figure 12 illustrates a cross section of the central area of the building, were the different levels of the roofing contribute to the natural ventilation of the room.

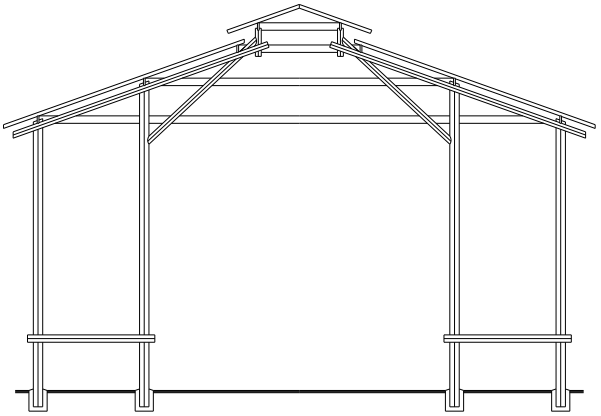

Figure 12: *Cross section of the central area of the building showing the different levels of the roofing*

The upper level of the roofing is supported by round wood braces that are jointed to the pillars and to the double beams, according to the details exposed in Figures 13, 14 and 15. This structural solution differs from traditional use of central supporting pieces and suggests that the upper roof is "flying".

The circular shape of this area comes from the distribution of the pillars and double beams in order to support the surrounding ramp. The use of bolted joints contributes to simplify the execution of the timber structure, although the perfect execution of the carvings in the pillars is mandatory to make an efficient joint with the double beams.

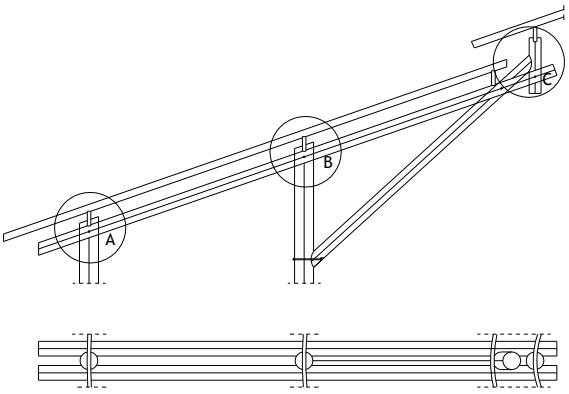

Figure 13: *Detail of the timber structure in the central area of the building*

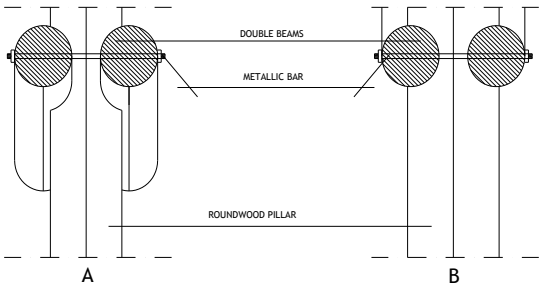

Figure 14: *Details of the joints between pillars and beams*

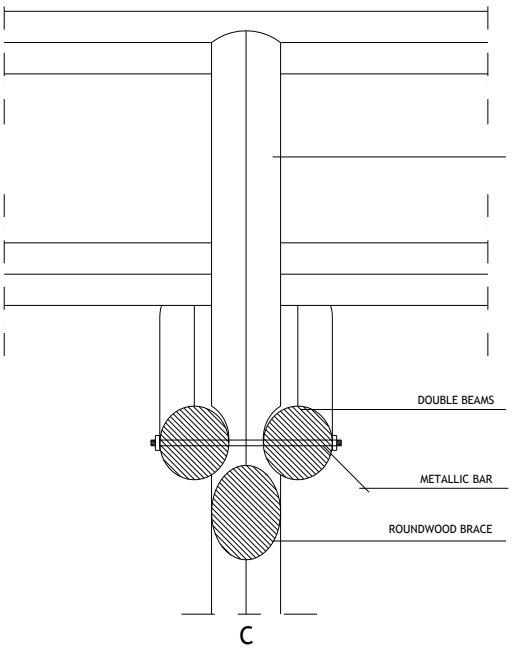

Figure 15: *Details of the joints between pillars and beams*

Coming out of the central area, there is a lifted pedestrian walkway that leads to the observation deck. Similar structural solution to the porticos was proposed, in order to keep architectural aesthetics. Figures 16 and 17 illustrate the detailed timber structure of the pedestrian walkway.

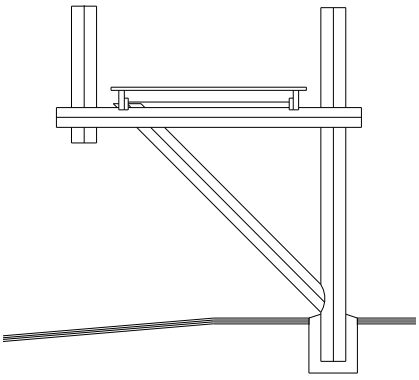

Figure 16: *Detail of the lifted pedestrian walkway*

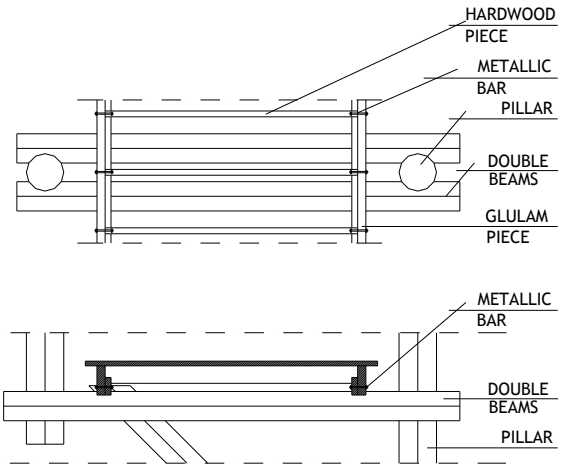

Figure 17: *Details of the lifted pedestrian walkway*

Complementing the implantation of the *Cerrado's* Information Centre, it was proposed a set of greenhouses that will surround the new building, where the visitors will be able to see orchids' collections. The Brasilia Botanical Garden has different orchids' collections that will be displayed at the greenhouses in order to be viewed by the public. Figures 18 and 19 show the plan and a external view of the greenhouses.

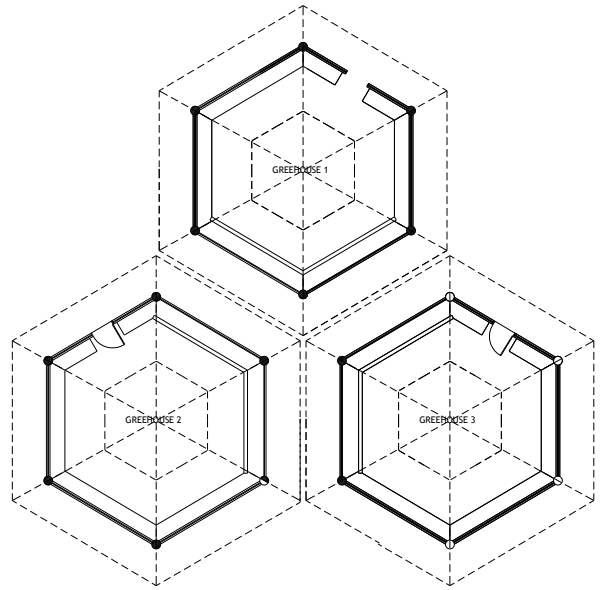

Figure 18: *Plan of the greenhouses*

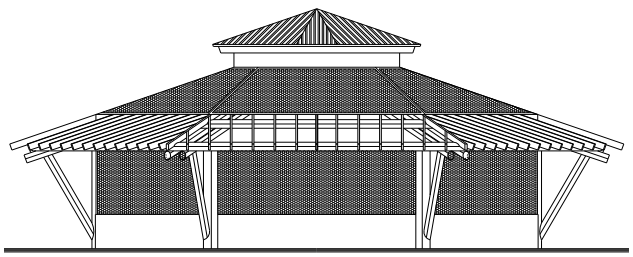

Figure 19: *External view of the greenhouse*

The structural solution is very similar to destined to the central area of the Centre. Rounded wood porticos were disposed in a hexagonal shape with two levels in the roofing. Figures 20, 21, 22 and 23 show the structural designs of these small buildings.

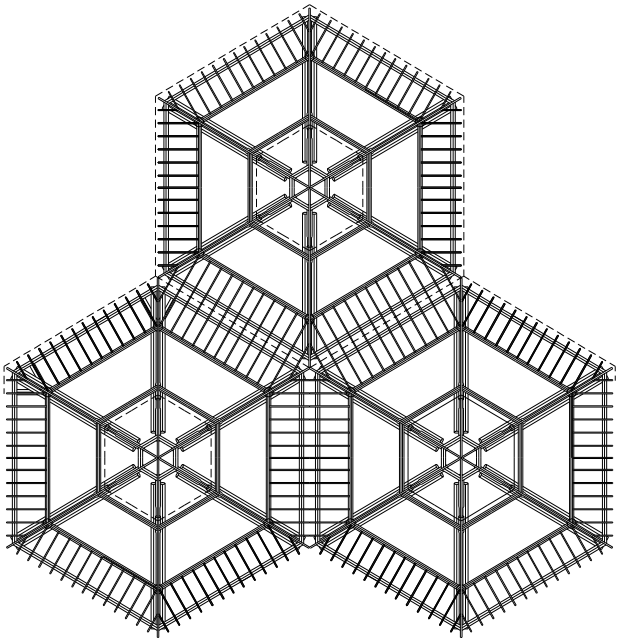

Figure 20: *Structure plan of the greenhouses*

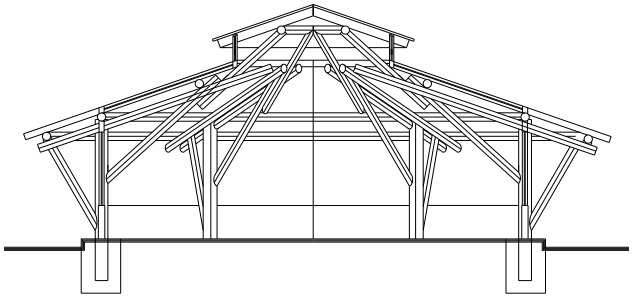

Figure 21: *Cross section of the building*

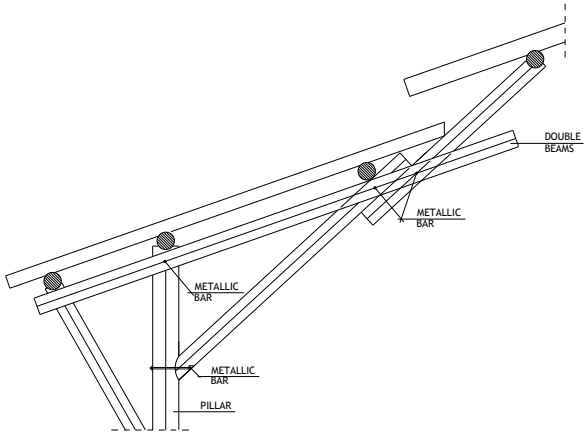

Figure 22: *Section of the structure*

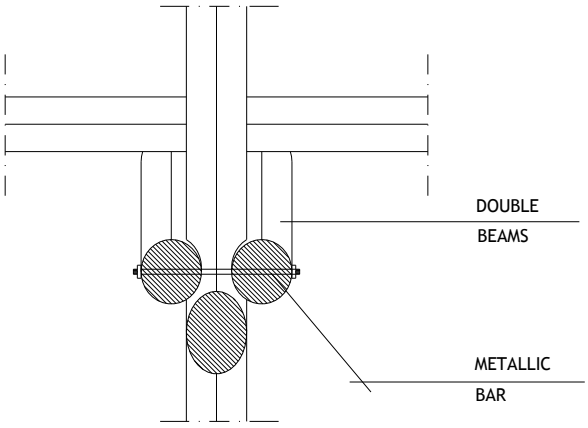

Figure 23: *Detail of the joint that supports the second level of the covering structure*

In all the buildings, the pillars will be fastened to concrete blocks that will be located in the top of the pile foundations. Figure 24 shows a detail of this constructive solution.

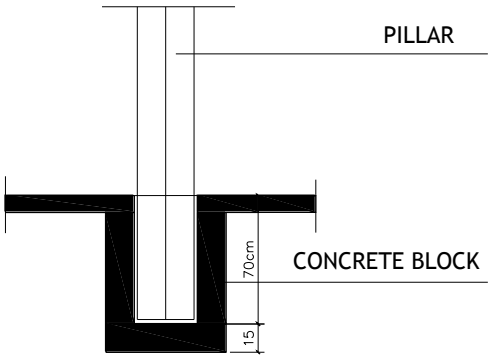

Figure 24: *Detail of the foundations*

4 CONCLUSIONS

The use of timber structures in the new building of the *Cerrado's* Information Centre is an evidence of the flexibility of this sustainable and locally sourced material. Brazil has a great potential related to the exploration of forest based products in a sustainable basis, and its potential remains unexplored.

In our region, we have several barriers to be broken before designing a timber building. The construction of these buildings is classified as expensive, and at the same time considered rustic or without quality. Questions like durability or the cost of maintenance are pointed out as disadvantages of the wooden buildings.

The more we design and build in wood, better will be our knowledge about this amazing material. In a country were the movement called Modern Architecture has elected the armed concrete as the "official" material of our buildings, build in wood is a challenge.

It should be pointed out the importance of demystifying the use of timber structures as "non-ecological" in our country, because wood is the only choice for a renewable and sustainable building material and wood materials are desirable for their strength, durability, beauty and cost-effective construction.

ACKNOWLEDGEMENT

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