WCTE 2014 Quebec City Canada August 10-14
World Conference on Timber Engineering

THE CONTRIBUITION OF ZANINE CALDAS TO TIMBER CONSTRUCTION IN BRASILIA: FOUR PROJECTS OF SELF-TAUGHT ARCHITECT

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ABSTRACT: Architectural references built in timber are not commonplace in Brazil. Zanine Caldas has legated some great buildings. The goal of this work is to present this architect's works from the 1960s up until the 1980s and, furthermore, to present some constructive characteristic that have made it unique, showing beautiful examples of timber construction in Brazil's central region. Visits have been made to many buildings, along with interviews, photographical records and other gathering of information, attesting the quality of constructive and structural details, besides architectonic components from the work of this self-taught architect, developed in the mid-west region of Brazil.

KEYWORDS: Zanine Caldas, Timber construction, Brasília

1 INTRODUCTION

In the 1980s, in Brazil, the architecture of Zanine Caldas has become synonym of quality timber construction, but his works are better known in the state of Rio de Janeiro, with a great number of buildings in the Joatinga neighborhood [1]. However, the collection of his works in Brasília also stands out for the amount and quality of its architecture.

Zanine passed away in Rio de Janeiro, in 2002, leaving a legacy of relevant interest for the quality of his architecture, besides a characteristic technique that has marked his architecture: the constant application of timber in the structural systems of his works.

Even though Zanine did not have a formalist training in any official architecture school, his accomplishments include striking passages in the Museée des Arts Decoratifs, in Paris, in 1990, or the receiving of public acclaim from Lúcio Costa for the legal exercise of the profession during the Brazilian Congress of Architecture in 1991. Still, he had a space reserved in the Architecture d'Aujourd'hui magazine, in 1987 [2], presenting one of his houses.

His apprenticeship took place in the persistent and constant accompaniment of the growing Brazilian architecture of the 1950s, following architects of the modern school of architecture, such as Niemeyer, Alcides da Rocha Miranda, Sérgio Rodrigues, and many other professionals. He began his work in the 1940s with a small scale models atelier, and this practice has marked his work, besides the good quality of his timber constructions.

The objective of this paper is to present part of the work from this unique architect in the city of Brasília, located in the mid-western region of Brazil, and the most striking characteristics of his work.

2 METHODS

Due to the lack of any record of information regarding his works in Brasília, the research included the gathering of information was made through authorized visits to his works, scattered by the Brazilian capital. There are no central records of the addresses of these works, therefore a research was made in the architectonic ---, for the confirmation of possible places and later contact with the actual residents, not necessarily the original owners of the house.

The work consisted in registering, by means of general and detailed photographs of all the works, recording, with authorization, the informal conversations with the residents, rescuing information from the beginnings of the construction and remaining information and records of the visited work.

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3 RESULTS

The first work accomplished with the information from the visits to Zanine's works in Brasília was the confection of small scale models of four of his projects. This work is still in the process of being presented in the form of an exhibition in the University of Brasília.

The remaining results of the registry of his works will be presented in the variety of door and window frames, in the constructive details of the structural connections, in the different types of solutions for the flooring structures, and also, in the diversity of the roof carpentry.

This collection of work from Zanine Caldas in Brasília comprises the period from 1960s up to the early 1990s, when he returns to the city of Rio de Janeiro. In the capital of Brazil his works amount to approximately 40 buildings. However, for the time being only four of these works will be presented.

3.1 ZEZITO RESIDENCE

Located in the Sector South of Individual Dwellings, or simply South Lake, as it is know, Brasília-DF. It was built in 1988 and has a built area of 1000m².

3.1.1 Presentation

A tree stories single family residence, with service and leisure areas in the ground level, while the intermediate level the holds the living room, dining room and the kitchen, and a third level the private areas, with the main suite of the couple and three more for each children. The floors are organized as three juxtaposed quadrangular modules and a central spiral staircase in the junction connecting the three levels. The style is modern and at the same time alludes the traditional Portuguese colonial architecture, as can be observed in Figure 1.

Figure 1 *– Main view*

3.1.2 Structure

The flooring structure is composed of three juxtaposed quadrangular modules, with two modules being 10x10m in the sides, and a third one with 11x11m. In each one of these modules we have the main feature that makes the structure unique: beams were rotated 45º around its longitudinal axis, giving a false impression that the section of the beams is losangular, when they are actually square. The individual flooring structure is composed of these rotated peripheral beams with a section cut of 30x30cm, the main diagonal beams with a section cut of 15x35 and secondary beams, called studs, with a section cut of 7,5x15cm, spaced at 50cm from each other along the peripheral beams. At the junction of the main diagonal beams, at the center of the module, there is a timber column from the Brazilian timber known as "acariquara" (*Minquartia guianensis* Aubl.). The peripheral columns are located away from the vertices of the module, making for a pair of columns at each corner. At the top of the pair of columns rests a rotated beam, plying the role of a coaster, receiving loads from the peripheral beams and the main diagonal beams. Above this structural set of the flooring a layer of concrete is cast that attaches itself to the timber components, the beams and studs, and is molded by wood boards that become a permanent ceiling This assembly is denominated a mixed structure slab, and occurs in all the upper levels. The columns at the ground level are all made of steel reinforced concrete, distancing the whole timber structure from contact with the ground. The "acariquara" timber column in the middle of the modules, shown in Figure 2, provides for a distinct aesthetic appeal to the interiors of the building. This solution repeats itself in the upper level, though in these levels the corner columns are made of timber, with a section 30x30cm. If in one hand this structural solution for the loads implies in a discontinuity of the columns, interrupted from one floor to the other, on the other hand it creates a very sturdy structural set and balanced load distribution.

Figure 2 *– Timber column in the middle of the square modules*

3.1.3 Roofing

Each quadrangular module is comprised of four slopes and displays the same structural hierarchy of the flooring structure, however, in this case the main diagonal ridge beams are sloped and do not have the middle column. In this way all loads from the roof are discharged onto the peripheral beams, restrained at the four vertices and, in turn, all its loads are transferred to the eight columns, two in each corner as can be seen in Figure 3. The peripheral beams act together as a traction ring. For the eaves of the roof a traditional Portuguese technique known as "*cachorro duplo"*, of oriental origin, was applied.

Figure 3 *– Ceiling view at the junction of two slopes.*

3.1.4 Enclosure

The walls are made of traditional ceramic brick masonry covered with mortar and painted white combined with broad glass panels structured in wooden frames with original intricate details. This assembly of masonry walls, wood and glass harmonizes itself with the door and windows and form the vertical enclosure of the building, as is presented in Figure 4.

In the horizontal enclosures of the floor wooden planks were used, fixed over the mixed timber and concrete structure slab. In the wet areas, such as kitchen and bathrooms, and in the whole rest of the ground floor, ceramic tiles and bricks were used.

As in all of Zanine's work, the architect leaves his mark in the project of the ceiling in the living and dining rooms, with small alternated sloped boards fit in between the timber studs from the floor directly above that produce a rhythmed movement, as is shown in Figure 4. The Ceiling of the second floor is installed directly over the rafters allows for the visualization the whole structural of the roofing. This detail can be seen in Figure 3.

Figure 4 *– Internal view of the ceiling, the central "acariquara" column in the foreground, and vertical enclosures at the back.*

3.1.5 Window and door framing

The solid wood doors, with its original drawings, show an interpretation of traditional decorative elements of the colonial architecture: the raised panels, which in this case show a concave shape instead of a convex, as show in Figure 5.

Figure 5 *– Panels, window and door frames.*

Slide hung and awning windows were used, all of which made of wooden frames and glass panels that show the same details as the wall panels. The stripes of wood flanking the window frames and stretching from bottom to top are another typical aesthetic element unique to Zanine's architecture, and can be seen in Figure 5.

3.1.6 Special works

In the junction of the three structural modules there is a solid wood spiral staircase that connects the three levels. It is structured in solid separate steps that are piled over one another and receive an angular twist one by one, as can be seen in Figure 6, allowing for the scaled steps. In the same Figure the staircase to the main access to the house is also shown. As with the internal staircase, it displays the marking constructive and formal characteristics of Zanine Caldas's works.

Figure 6 *– Stairs details*

3.2 OBERLANDER RESIDENCE

Located at the edges of Lake Paranoá, in the North Lake Mansions Sector, Brasília, this house was built in 1989, and has a total area of 450m² (all edifications).

3.2.1 Presentation

A two stories single family residence it shows characteristics that allude the Brazilian colonial as well as Japanese architecture, and yet following the typical layout of modernism, with strong hierarchy of social, private, and service areas, provided by the differentiated vertical enclosures and floors.

At the ground level area the dining room, a guest room, service areas, and leisure areas in general, with a veranda that allows access to the garden and the swimming pool. On the first floor area the couple's suite, the children's room, living room and kitchen, all connected by a veranda that connects the spaces from the outside. The project shows a multiplicity of refined carpentry elements, and a rustic appearance, due to the timber elements used in the structure, seen in Figure 7.

The spaces in which more time is spent are all located towards the rising sun, providing comfort to its users.

Figure 7 *– Main access to the house.*

3.2.2 Structure

The floor structure is formed by a hierarchy of main and secondary pieces set up as a scheme of two squares in which one is rotated by 45^0, forming an eight pointed star.

The columns are round section solid timber pieces located at the center and outer edges of the building, as shown in Figure 8, all of which are continuous from the foundation to the roof.

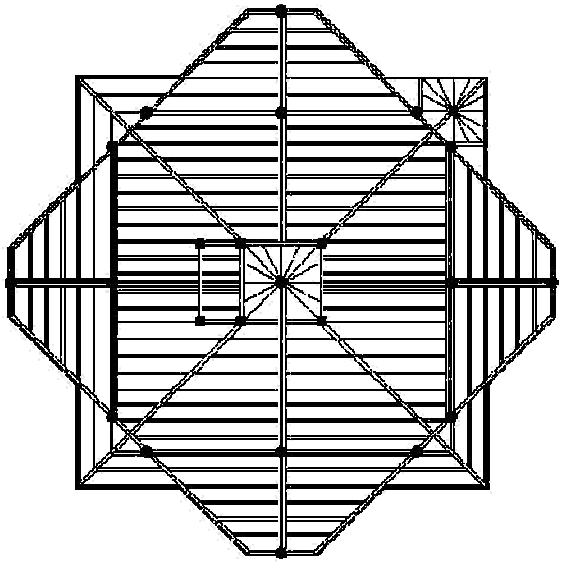

Figure 8 *– Floor structure in eight-pointed star scheme.*

The main and edge beam systems have 10x30cm section cut pieces, and the secondary structure has 7,5x15cm section cut stud pieces, onto which the floor planks are directly nailed.

3.2.3 Roofing

Following the scheme of the floor structure, as presented in Figure 8, the roof is one of the highlights of the building, with four slopes that give a false impression of being actually eight.

To the center is a skylight that allows for natural light and ventilation, and rendering columns at the location unnecessary, shown in Figure 9. This structural hierarchy presupposes a balanced structural set of forces that cancel each other out, unloading forces onto the peripheral columns. Taking this distribution into consideration, we find a tension ring formed at the structural frame of the peripheral beams, as well as a compression ring formed by the skylight structure. It is important to highlight the extended eaves of the roof, supported by knee braces. The eaves of the roof show the traditional Portuguese technique of "*cachorro duplo*", seen in Figure 10, extending it with the accretion of two extra rafter pieces, making for a 1,5m eaves, that better protect the verandas and walls from the climate.

Figure 9 *– The skylight and roof structure.*

3.2.4 Enclosures

Traditional ceramic brick masonry combined with glass panels on wooden frames make for most of the vertical enclosures. Another of Zanine's trademarks, seen in Figure 10, shows the wooden stripes from bottom to top that frame the doors and windows on the masonry walls.

For the floor enclosures wooden planks were nailed to the studs and beams of the structure below, making also the ceiling of the floor below. In the upper level the ceiling is enclosed by small 15cm wide wooden boards fixed in between and perpendicular to the rafters, allowing the slanted roof structure to be seen, as shown in Figure 9.

Figure 10 *– Vertical seals and prolonged eaves*

3.2.5 Window and door frames.

The house has examples of single hung windows on which the frames receive original designs made by rotated squares with colored glass panels. The doors, in solid wood, show raised panels, a traditional Portuguese work. Both doors and windows were installed on wooden posts and bar frames. All of this can be seen in Figure 11.

Figure 11 *– Door and window frames.*

3.2.6 Constructive details

The verandas' handrails in the upper level make for another example of Zanine's refined designs, on which rotated square pieces, resembling the Portuguese raised panels, were installed, having an intricate geometry that is shown in Figure 10.

The main spiral staircase has steps that are structured on wooden posts at the edges and a central post in the middle. Moreover, the steps are connected to one another by square section wooden bars that form a rigid structure between the posts. This detail is shown in Figure 12.

Figure 12 *– Central staircase.*

3.3 BETHIOL RESIDENCE

This residence is located in the North Isolated Mansions Sector in Brasília. It was built in 1978 and has a total built area of 1200m²

3.3.1 Presentation

Possibly one the most representative works of Zanine, not only in Brasília, but also in Brazil. Displaying a strong aspect of Zanine's work, the project draws heavy influences from the houses of the Brazilian colonial period, something which is still more evident by the use of very large solid timber structural elements that have a rustic feel due to its not being processed. In the house, another typical element from colonial architecture, the verandas, play a fundamental role, connecting at the first floor the three modules that comprise the building, seen on Figure 13.

Built in a slightly sloped site approximately three meters high, the terrain connects itself to both to the ground and upper levels. In the upper level the social hierarchy of the house is clear, separating the social spaces in the middle from the private ones in the extremities. In this way, the main social access is made by a footbridge at the upper level that leads to the living room located at the center. In this space a spiral staircase is present, allowing the access from the living room to the dining room located at the ground level, and in the same social, central module. A wide veranda circles the central module, in both levels, making the connection, at the upper level, with the private areas. This scheme was employed due to the owner's request, and should separate the couple's areas from the ones destined to the children, both connected to the central social module. This module is offset from the axis that articulates the other two, standing out from the rest. At the back of the house are the kitchen, service and laundry areas, storages and an atelier.

Figure 13 *– Main view.*

3.3.2 Structure

The timber structure is structure is strongly present in the project, in a structural column and beam solution. However, the slabs of some areas concrete was applied, as is the case with the children's rooms, the couple's suite and in the main access to the social areas, above the kitchen and in the remaining service areas. The main module is comprised of natural round section timber columns, as is shown in Figures 14 and 13. The layout of its twenty-eight columns forms an octagonal beam frame, enclosing the interior of the module, and a four pointed star beam frame on which the upper verandas the circle the module are structured.

Figure 14 *– Living room columns.*

3.3.3 Roofing

The roofing of the three modules is traditional, with ceramic tile claddings, four slopes in the couples module, two slopes in the children's and four in the central module. The later displays an original geometry, that follows the four pointed star scheme of the verandas below. The octagonal layout of the inner columns and rafters provide for an optical illusion, viewed from the inside, of an eightfold roofing structure, which is actually fourfold. The radial layout of the rafters, resting also on a central compression piece, enhances this effect, as can be seen in Figure 15. Over the verandas the roof structure is the usual scheme of parallel rafters leaning on the peripheral and ridge beams. At the eaves of the roof the extending rafters receive double knee braces, seen in Figure 17. The structural scheme of the central module roof forms two tension rings made of the verandas' beam frame. The image formed by the scheme of the ceiling in the interior resembles a wheel from an old traditional ox wagon.

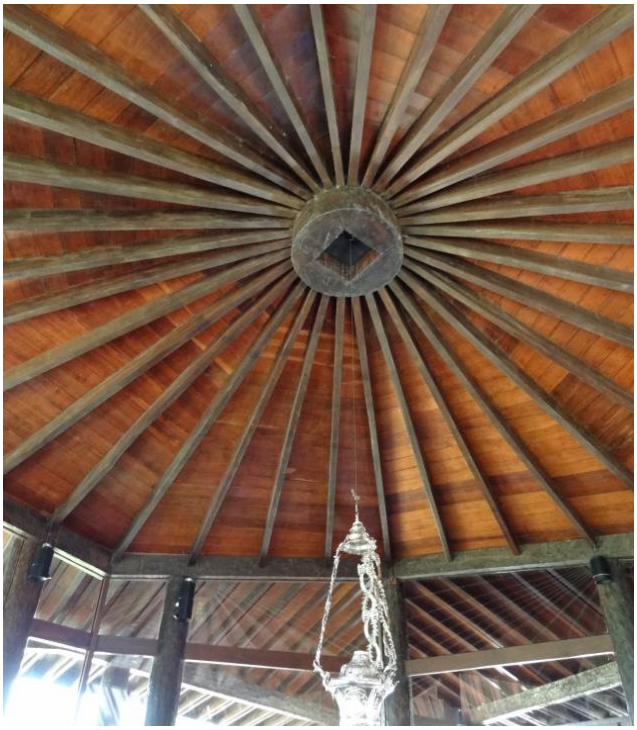

Figure 15 *– Ceiling in the central module.*

3.3.4 Enclosure

In general the walls are made of traditional ceramic brick masonry. The central module has a unique enclosure scheme comprised of broad glass panels structured either on wooden frames or directly into the scores made in the structural columns, allowing panoramic views of the garden and the nearby lake, as well as plentiful natural lighting. Furthermore, artistic tile work by Brazilian artist Athos Bulcão can be seen on some walls of the house, as shown in Figure 16.

Figure 16 *– Verandas and internal spaces enclosures.*

As for the floor enclosures, we find ceramic tiles at the ground floor. The upper levels is almost all sealed with long wooden planks, nailed directly onto the studs of the verandas, shown in Figure 17, or simply attached to the concrete slabs as in the children's room and the couples suite

Figure 17 *– Flooring and roof over the verandas.*

3.3.5 Door and window framings

The doors of the central module are made of solid wood, in the traditional colonial style, with its typical raised panels, as in Figure 16. In the rest of the house three wooden planks were joined together using male/female side grooves, as in Figure 19.

The single hung windows are made of glass panels in wood frames, and the low awning windows, typical of Zanine's work, allowing for natural ventilation, as is present in Figure 18.

Figure 18 *– Details of the walls and window wooden frames.*

3.3.6 Constructive details

There are two spiral wooden staircases of quadrangular projection, structured on wood posts. The first one in the interior of the central module, in the social area, seen in Figure 19, and the second one placed at the front of the children's module, allowing the external access between the verandas. There is also a cast iron spiral staircase that leads, from the exterior, to the couples module that was saved from a demolition.

Figure 19 *– Staircase in the middle module.*

The handrails are robust and made of solid wood pieces that were installed directly into gaps in the structural columns, with intermediate posts in the same style where the interstices are greater. The lighter color of the wood employed puts them in frank contrast with the darker wood of the structure.

3.4 LAURENCE RESIDENCE

Located in the North Lake Mansions Sector of Brasília-DF, the house was built in 1984 and has a built area of 1200m².

3.4.1 Presentation.

A very large single Family residence, built on a steep slope, approximately seven meters high, close to the Lake Paranoá, it is three stories high. The volume projects itself out from the slope, having at its end a wide and high veranda, with privileged view to the lake. Bevels and cuts in the geometry of the volume create balconies and nooks in the facades. The main access to the house, for cars and people, happens at the third, top level, giving the false impression of a one story house, as can be seen in Figure 20. This entrance leads to all the social areas of the house, and a mezzanine where the study is located. On the second floor are located the laundry and service areas with storage rooms, as well as maid rooms, children's rooms and the couple's suite. On the ground level there are guest rooms, an atelier, and a small gym, that opens itself to the garden.

Figure 20 *– Main entrance.*

3.4.2 Structure

The part of the house that is buried into the slope is structured in steel reinforced concrete, which combines itself with the rest remaining timber structure, structured on very large columns of the "acariquara" Amazonian timber at the centre, and metal and "ipê" timber columns at the outer parts. The main beams, of 10x30cm section cut, of the flooring structure, made of "ipê" timber, form quadrangular modules that receive timber studs, of

7,5x15cm section cut, over which steel reinforce concrete slabs are cast, as shown in Figure 21. The very tall continuous “acariquara” timber columns allow for a tall ceiling height in the interior of the living and dining rooms, which can be seen in Figure 22. The rustic and peculiar surface appearance of the “acariquara” timber used for the central columns gives the impression that the whole tree was brought to the interior of the house, also visible in Figure 22.

Figure 21 *– Structure being built.*

3.4.3 Roofing

The geometry of the roof, that follows the scheme of the floor plan, organizes the interior spaces and forms a wide hall. The roof itself is formed of four slopes and a long ridge, comprised of structural modules of quadrangular projection, as in the floor structure below, formed by main beams and rafters. In the middle of the roof one can find a skylight, allowing natural light into the living and dining rooms, seen in Figure 22.

Figure 22 *– Ceiling in the main hall and social areas.*

3.4.4 Enclosures

As with other Zanine houses, the vertical enclosures were made of traditional ceramic brick masonry, as shown in Figure 23, as well as broad glass panels installed in wooden posts of square section, rotated by 45^0, as shown in Figure 24, providing for a distinct aesthetic effect present through Zanine’s work. These broad glass panels are widely employed in the third level, and allow plentiful natural light in. On the remaining levels the traditional masonry walls and wooden frames were used.

For the floor enclosures of the wet and service areas ceramic tiles were used. For the private areas wood planks were attached to the slim concrete slabs, as in the rooms.

Figure 23 *– Wall seal and handrails detail*

The large main hall receives an original ceiling enclosure, installed along the length of the rafters, making for a pleated surface effect that, due to the light color of wood employed, contrasts with the darker wood of the structural pieces. For the lower levels simple wood planks of the same color were used, nailed to the studs. Furthermore, the extended rafters at the eaves of the roof receive the same wood boards that conceal the structure above letting show only the double knee braces employed, which can be seen in Figure 23.

3.4.5 Door and window frames

The doors of the social areas are made of solid wood and were decorated with planks of the "acariquara" that, sawn along the length of the trunk, create a unique effect of empty and full spaces and a beautiful natural drawing, as shown in Figure 24. This is something very unique to Zanine's style.

The single hung windows employed in the services and private areas are made of the typical glass and wooden frames combined with double casement Venetian windows, shown in Figure 23.

Figure 24 *– "Acariquara" planks decorate a door installed in wood and glass panels.*

3.4.6 Special works

A single spiral staircase connects the three levels of the house and the study located in the mezzanine, shown in Figure 25. Its structure is made from the piling and rotation of solid wood steps, of an original geometric shape that gives it a sculptural aspect.

The wooden handrails are made from two slender planks that are braced by a central wood panel with a concave woodwork. The whole set is rested on small rotated wood cubes that serve as intermediate posts.

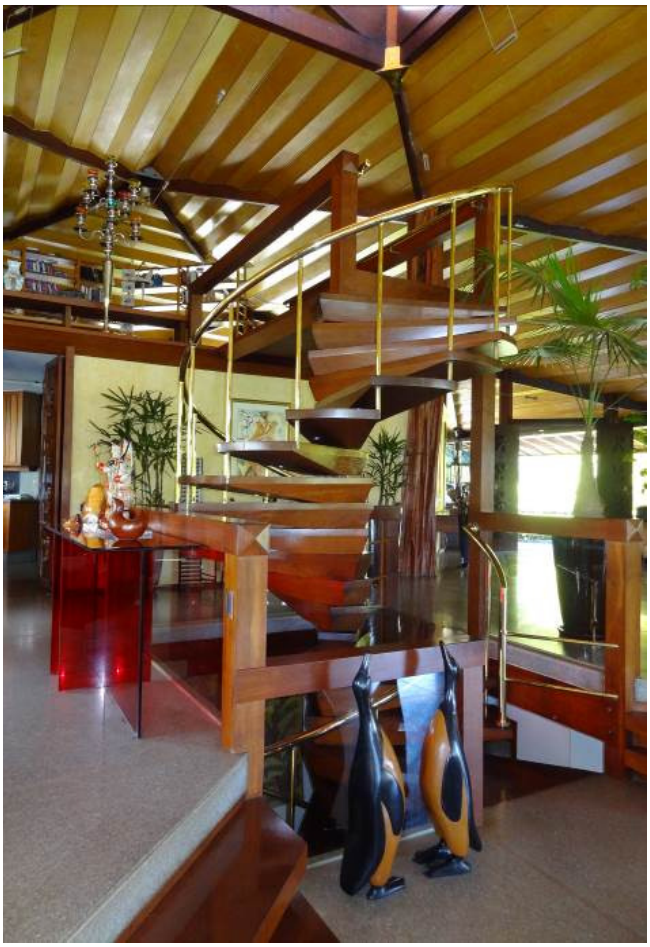

Figure 25 *– A continuous spiral staircase connects all three levels.*

4 CONCLUSIONS

Having presented these four samples from Zanine's work in Brasília, the capital of Brazil, one can easily see the wealth and quality of his work. In this article emphasis was placed on structural aspects of the flooring and roofing structures, as well as on vertical and horizontal enclosures (walls and floors), and on the door and window frames. In each of these parts much care and thought were applied to the aspect of the design, which was always a priority. Due to the size limit of this article, many constructive details have to be presented at another time, as for the roof eaves systems, the skylights, ceiling and floor designs, furniture and many others.

Noteworthy is the fact that, more than twenty years past his most recent work in Brasília, Zanine's works continue to show the same relevance and uniqueness, both due to the quality the constructive solutions and rigor of the structural carpentry, and to the quality of the architectural work, with beautiful examples of timber structured buildings.

ACKNOWLEDGEMENT

Special thanks to the members of the Work Group for Wood in the Small Scale Models Laboratory in the School of Architecture of the University of Brasília. Deserving attention in this gratitude are the families that allowed the visits to their houses, supplying the necessary information, relevant sources, to the results of this research.

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