



## **The scientific station of *São Pedro* and *São Paulo* Archipelago - Brazil**

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### **ABSTRACT**

The archipelago *São Pedro and São Paulo* is located over the São Paulo tectonic fracture (00°56N e 29°22W), about 945 km from the state of Rio Grande do Norte, Brazil. The larger islands have an area of approximately 7.500 m<sup>2</sup> and the highest altitude is 17 m. The local occupation - classified as one of the most inhospitable Brazilian places for the human life - was motivated by scientific, economic, and strategic factors. Conceived in an innovative system using timber (slab beam), the Station was mounted in only 12 days, and it is composed of main building (49 m<sup>2</sup>), system of salty water treatment to obtain fresh water (desalinized by reverse osmose, tanks, and pumps), system to capture energy (photovoltaic plates, inverters, and batteries), communication system, deposits, and mooring place. The project was proposed with the objective of minimum impact to the environment and maximum comfort taking in account the natural conditions of the region.

### **INTRODUCTION**

Located on the tectonic fracture of *São Paulo* (00 56N and 29 22W), *São Pedro* and *São Paulo* Archipelago is approximately 610 km far from the *Fernando de Noronha* Archipelago and 945 km of Rio Grande do Norte State, being composed by 15 small islands with 15,000 m<sup>2</sup> of a total area and maximum altitude of 17 m. It is said to be the most inhospitable place for the human life according to fishermen, scientists and visitors. The absence of fresh water and vegetation, the agitated sea, the great amount of sharks and crabs, the frequent seismic disturbances, the birds and the distances of the coast are elements that make any construction attempt in the place a challenge. The studies and investments for the Archipelago occupation are based in the following interests: 1. economic: tunes abundance and ornamental fish; 2. scientific: geology (unique geological formation; seismography), climatology (important meteorological data), ornithology (presence of two species of sea birds), oceanic and fishing engineering (large presence of fish and, in smaller number, of marine turtles), behavior (isolation condition and aggressiveness of the place); 3. strategic: geographical location and sea limit expansion.

The objective of this study was to design and build a scientific station in *São Pedro* and *São Paulo* Archipelago, with 50 m<sup>2</sup> of area.

### **THE ECASPSP - THE SCIENTIFIC STATION OF SÃO PEDRO AND SÃO PAULO ARCHIPELAGO - BRAZIL**

#### The conditions

For the architectural project development and the constructive technique, two expeditions were sent to the Archipelago. Starting from the choice of the implantation place, which was preceded of criteria and methodology previously established, the implantation program was elaborated based on the following conditions:

- The Archipelago is defined as APA – Area of Environmental Protection, demanding minimum environment interference during implantation and use of the Station;

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- The environmental conditions are unfavorable, being especially considered the following aspects: hot and a humid climate, rocky soil without occurrence of beaches, abundance of sharks and birds (hindering the marine transport and impeding the use of aircrafts), violence of the seas, the rare plane areas, sharp and dark rocks (radiation absorbent) in the whole extension of the islands, abundance of rains in certain times of the year;
- Occurrence of earthquakes of intensity VI and VII in the Modified Mercalli scale (Rose, 1996);
- Maintenance difficulty because the distance of the port, the closer provisions is about 945 Km of distance, and need of self-sufficiency in the complementary facilities;
- Absence of equipments and specialized labor so much in the assembly of the Station as in its subsequent operation;
- Reduced execution period;
- Occupants stress due to isolation and the environmental characteristic.

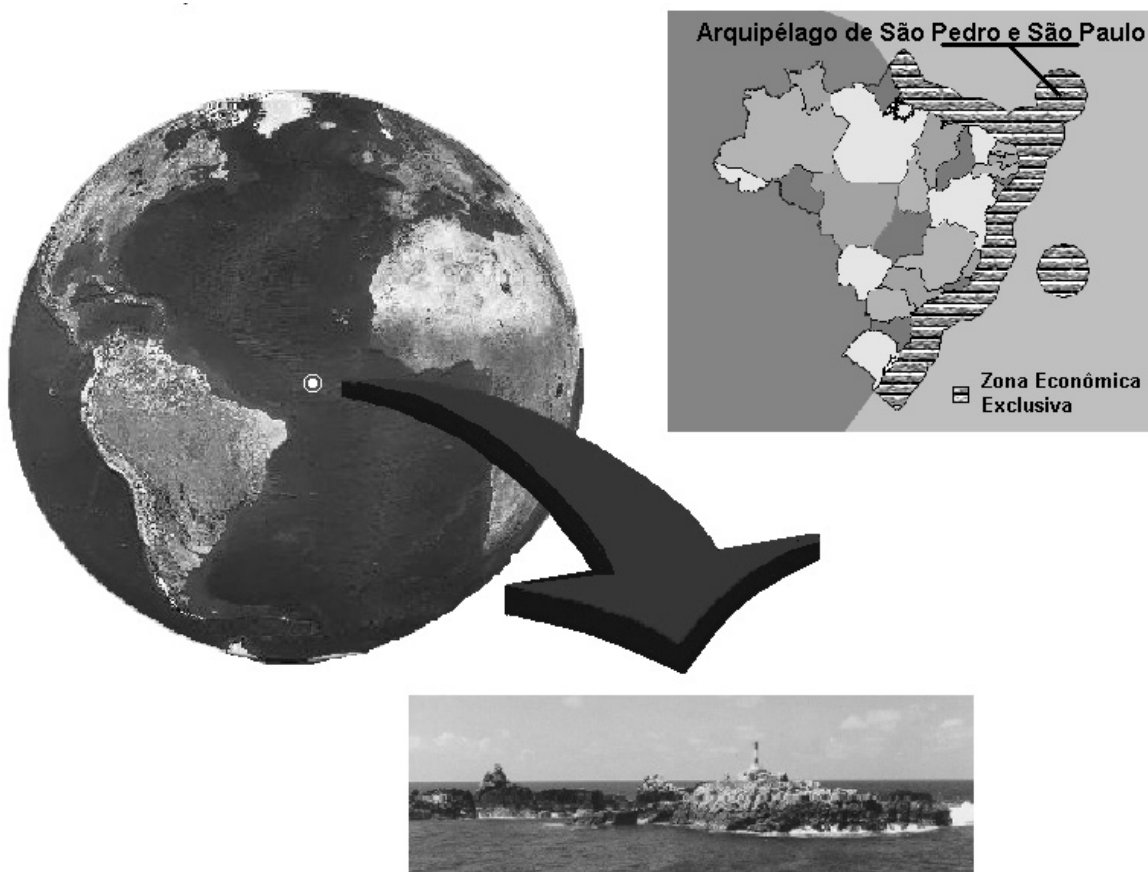


Figure 1. - Archipelago location, view of the islands and the exclusive economical zone map.

### Methodology

The project for the Scientific Station of São Pedro and São Paulo Archipelago was elaborated starting from previous studies developed in similar areas, such as Antarctica and the Atol das Rocas. For the specific situation of the Archipelago, constructions subject to seismic tremors were studied and evaluated the solutions. Some preliminary tests for the proposed projects were done. Parallel to the researches related to the structural system, the thermal comfort was simulated. The architectural and structural projects were developed in total coherence with the complementary projects - fresh water and energy production based on a photovoltaic system (Figure 2). It is pointed out as fundamental part in the adopted methodology, the project evaluations made in the following stages:

- Presentation of the architectural project to future users, builders and responsible for the subsequent maintenance;
- Model fabrication for initial tests and as auxiliary instrument of development (Figure 3);
- Tests with materials and the adopted techniques;
- Parts fabrication and assembly tests;
- Evaluation of assembly efficiency and of maintenance in the adopted constructive technique;
- After activation (in process).



Figure 2 - The main building of ECASPSP having in the back the Ship Admiral Graça Aranha.

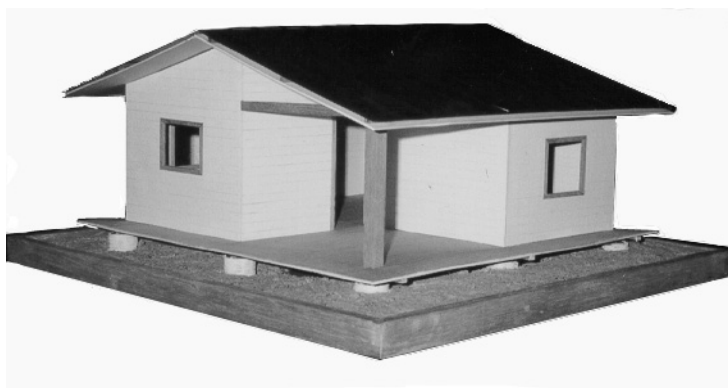


Figure 3 - Model of ECASPSP.

### The Architectural and Structural Project of the Main Building

The Station was designed to shelter up to four researchers for 24 days, which may be extended to 60 days. The main building has about 49 m<sup>2</sup>, distributed in five rooms: bedroom, kitchen/dinner; room of radio/living room, sanitarium and balcony (Figure 4).

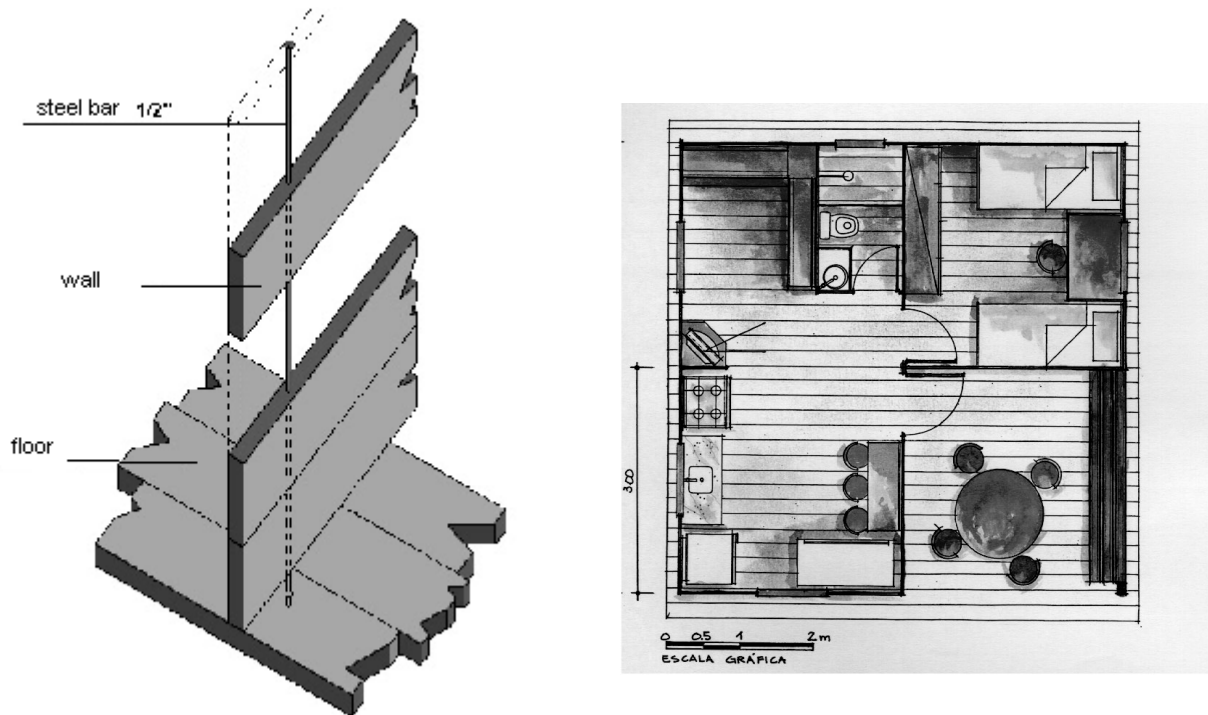


Figure 4 - Schematic draw of the beam-slab system and the main building blueprint.

The constructive technique was especially conceived looking for coherent structural solutions with the possible occurrence of seismic disturbances and with the available means of transportation. A prefabricated constructive system was developed, where the wood pieces that form the walls, floors and coverings were jointed together using screwed bars of galvanized steel, forming rigid panels. The system does not use pillars. The station foundation was based on small concrete slabs having specially designed pieces of rubber as interface between the floor and the foundation. The wood and concrete pieces were manually transported in small air inflated boats from the ship to the island due to lack of auxiliary equipment. This was a limitation for the size and weight of all parts.

The architectural conception looked for integration with the complementary systems, especially the source of energy, developed by CEPTEL (Galdino, 1998). Such system, based on photovoltaic plates, had as main consumption factor the equipment destined to the extraction of drinking water besides the other necessary equipments to the operation of the Station. The Station was set up in only 12 days, after about three years of studies, preliminary tests, making of the pieces and assembly tests. It had for a conceptual guideline the need to work as a small city, guaranteeing the survival and the well-being of the occupants, the self-sufficiency and the preservation of the environment. The main actions, related to the user comfort and looking for the maximum energy efficiency in all the adopted systems, were:

- Adoption of wood as main constructive element, so much for the thermal qualities of the material as for the pleasant sensation to the touch;
- The design looks for a direct relationship with the image “home,” moving away the idea that the users are part of any technological innovation or scientific experiment;
- Orientation of the openings favoring crossed ventilation;

- Covering in wood with polished aluminum, reducing the radiation absorption;
- Permanent ventilation system in the superior contour of the construction;
- Suspended floor allowing underneath ventilation and isolating of possible ascending humidity;
- An external balcony that facilitates integration between the exterior and the interior;
- Placement of noisy equipments far away of the rest place and bedroom;
- Earthquake proof furniture and optimized in relation to the limited available internal space;
- White external painting and sand color interior;
- Electric equipments specified by CEPTEL, Eletrobrás - The major Brazilian electric research center.

With relationship to the comfort, stand out the adopted measures linked to the psychological comfort, since the situation and place tend to worsen users' stress.

After inauguration, a contention wall was built to protect the station against strong sea waves. The wall was built in wood and had openings to allow ventilation. (Figure 5)



Figure 5 - The contention wall built to protect the station against strong sea waves.

### **FINAL COMMENTS**

The concepts of environmental design were absolutely respected, standing out the building typology, the adopted constructive technique and the complementary equipment, looking for self-sufficiency and minimum environmental impact so much in the construction as in the use of the station. The station was set up in 12 days (June of 1998) after 3 years of studies. It has autonomy of 24 days holding a team of 4 researchers. This capacity may be extended up to two months.

After its inauguration on June 25, 1998, the Station suffered small modifications being possible to verify the solutions adopted to the challenge initially set. Now the After Occupation Evaluation is being developed (APO) objectifying the systematic collection of data for posterior application in this and in others similar projects.

The construction of the Station counted with the support of CIRM - Comissão Interministerial para os Recursos do Mar, the National Sea Resources Commission, that coordinates the PROARQUIPÉLAGO - São Pedro and São Paulo Archipelago Program. The construction and development of the station was accomplished in Brasília, at the Forest Products Laboratory of IBAMA, Brazilian Institute of Environment and Natural Renewable Resources.

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