Casa de Vidro
Lina Bo Bardi architect

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CASA DE VIDRO

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Conservation Management Plan

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The collaboration of the Institute of Architecture and Urbanism of the University of São Paulo with the Instituto Bardi for the production of the Casa de Vidro Conservation Management Plan, with funding from the Getty Foundation, is a special moment of long cooperation in the form of research activities, teaching and extension.

The first master's thesis written on the Casa de Vidro was held at the USP Graduate Program in Architecture and Urbanism in São Carlos, in 1995, by architect Maria de Fátima Campello in the Arqbras Research Group. Professor Anelli's research at the Instituto Bardi goes back to his surveys on the role of Italian architects in São Paulo, supported by CNPq since 1996.

Since then, several researches on Lina Bo Bardi's work have been developed at IAU, illuminating little-known aspects of her career and presenting new interpretations of her work. For this reason, the Instituto Bardi invited the IAU to establish the current collaboration agreement to preserve the Casa de Vidro. The plan published here is the result of this cooperation.

By deciding to produce the plan in an academic institution, the Instituto Bardi contributed to the mobilization of a team of more than 20 researchers and consultants, an important stimulus for the formation of new generations of architects interested in the preservation of historical heritage.

Miguel Antônio Buzzar
Dean of the Institute of Architecture and Urbanism
University of Sao Paulo / Campus São Carlos

Founded in 1990, the Instituto Bardi / Casa de Vidro keeps alive the objective of promoting and stimulating the study of art and architecture in Brazil, as defined by its founders, Lina Bo Bardi and Pietro Maria Bardi.

Headquartered in the iconic residence designed by Lina Bo Bardi, the Institute arouses double interest: it houses a relevant collection of over 40,000 items and is an important modern architectural heritage in the city of São Paulo, listed since 1987 by Condephaat [Council for the Defense of Historical, Archaeological, Artistic and Touristic Heritage].

The selection of the Casa de Vidro project by the Getty Foundation for its Keeping It Modern (KIM) program has enabled the Instituto Bardi to update itself on the contemporary methodologies for preserving modern architecture.

To meet the challenge of building a long-term policy for the preservation of the Casa de Vidro, a team of heritage experts, architects, architectural historians, landscape architects, civil engineers and consultants was mobilized.

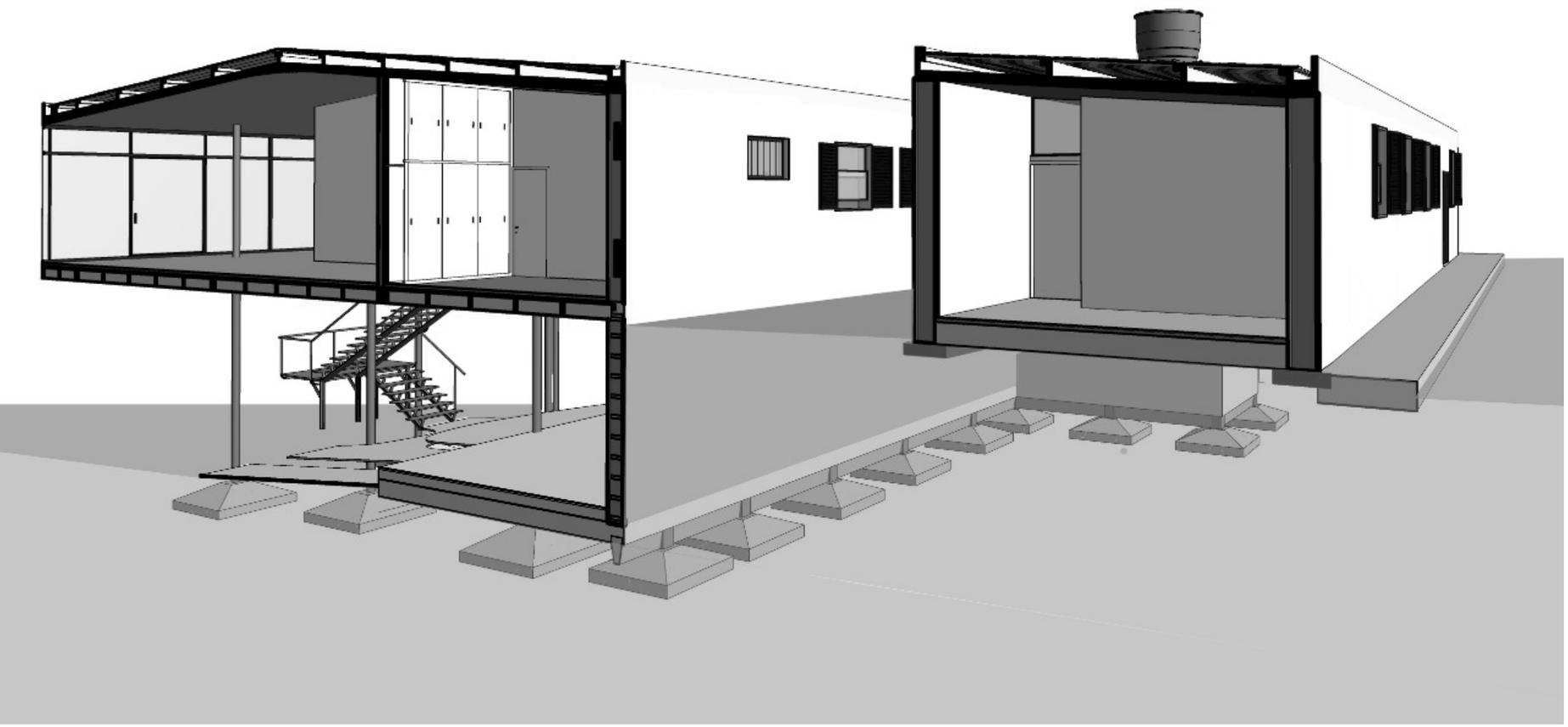
The partnership with the Institute of Architecture and Urbanism of the University of São Paulo in São Carlos (IAU USP) gave to the project a formative dimension of undergraduate and graduate students, stimulating research groups and laboratories.

The development of the survey opened new fields of international dialogue for the Brazilian team. Seminars and workshops brought then closer to researchers from different countries, generating an exchange of methodology and technology.

The participation of the Institute in the KIM program is consistent with the importance of Lina Bo Bardi in the field of knowledge on restoration, internationally recognized. By producing its long-term preservation management policy, in accordance with the methods proposed by the KIM program, the Casa de Vidro becomes a contemporary preservation reference itself.

The Instituto Bardi / Casa de Vidro thanks the Getty Foundation for their support and trust in this endeavor, and the team mobilized by the project, both essential to the results achieved. The legacy of the Bardi couple thus finds a new place in contemporary times, proposing the most up-to-date conservation practices of modern architecture.

Sonia Guarita do Amaral
Chair of the Administrative Council
Instituto Bardi / Casa de Vidro



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Executive summary

The preservation of the Casa de Vidro stems from the plans of the couple Lina Bo and Pietro Maria Bardi. In the last years of their active life, the couple began the process of declaring the building a historical heritage site, demanded at the Council for the Defense of the Historical, Archaeological, Artistic and Tourist Heritage (Condephaat, 1986), and founded a non-profit cultural association, the Bardi Institute (1990), which would become the owner of the house after the death of Lina and Pietro – respectively in 1992 and 1999 – and responsible for its preservation. In order to finance its operation, they endowed the Institute with funds from the sale of a painting from its collection. The plan was successful, the Casa de Vidro was kept in a good state of preservation and the Institute stood out for its performance in promoting Brazilian art and architecture, while still preserving the couple's valuable collection.

Nevertheless, despite numerous fundraising projects for the Institute's activities, the original fund ran out in 2014. Without the security backing of those funds, the Institute has continued to function thanks to the voluntary efforts of many people, as well as for the resources obtained from the copyright of Lina's works and from Petrobras' cultural support, which began that year. But uncertainties arising from fluctuations in cultural policies in Brazil impacted the Institute, leading to the interruption of this support in 2016.

This situation makes it clear that the main challenge for the preservation of the Casa de Vidro is the achievement of its long-term financial sustainability. Despite the interruption of Petrobras' support, three initiatives of the Institute have allowed it to continue its operation and underpin its current moment.

The first of these initiatives was the Institute transformation from a Non-Profit Cultural Association to a Social Organization in the Culture Area, adding more professional and efficient operating parameters. The second was the realization of the transfer of the building potential of part of the land of the Casa de Vidro, raising resources for priority interventions for its preservation and adaptation to the house museum functions. And the third was the successful submission of a proposal for the Getty Foundation's Keeping It Modern program, in partnership with a group of researchers from the Institute of Architecture and Urbanism (IAU) of the University of São Paulo (USP), that allowed the elaboration of this Plan of Management and Conservation.

Being a specimen of 20th Century Modern Architecture, the Casa de Vidro presents similar conservation problems as those found in other buildings and similar sites in many countries around the world. In order to respond to these challenges, the Getty Foundation has developed the Keeping It Modern program, a support for the production of studies and proposals for the preservation of important 20th century buildings.

Since the program began in 2014, funding destinations have been decided from proposals made by institutions around the world, which are then examined by Getty Foundation's experts. In August 2016, the Casa de Vidro was the third Brazilian project to receive support from the Getty Foundation in this program, after the USP School of Architecture and Urbanism (designed by João Batista Vilanova Artigas and Carlos Cascaldi), in São Paulo, and the Burle Marx's panel at the Arthur Neiva Pavilion of the Oswaldo Cruz Foundation (designed by Jorge Ferreira), in Rio de Janeiro, both in 2015. The following year, 2017, the São Paulo Art Museum (Masp) would also be selected to participate in the program.

At the beginning of the preparation of the proposal, in 2015, the Bardi Institute chose to carry out the preservation project with university researchers, instead of with a specialized company. In addition to the long history of partnerships with scholars dedicated to the study of the couple's work, the agreement with USP would bring the most innovative in the preservation area in the country, while encouraging the formation of new researchers in the area, one of objectives set out by the founders of the Bardi Institute.

Developed over three years, the Conservation and Management Plan has enabled a broader assessment of conservation needs, extending the surveys to the garden and the annexes – Caretaker's House, Garage and Studio. In accordance with Getty's announcement, which follows the Burra Charter (document produced by the International Council of Monuments and Sites, ICOMOS), the plan includes aspects of institutional management and use program, without which the physical preservation of the property risks to be limited in time.

By participating in the Keeping It Modern program, the Bardi Institute proposed to combine four research fronts, called tasks:

- Task 1: Systematize the documentary study of the history of the house.
- Task 2: Perform careful digital surveys of the architecture of the main building, attachments and garden.
- Task 3: Identify the conservation status of building systems, especially their structure.
- Task 4: Evaluate the garden situation, understood as a fundamental element of Lina and Pietro's conception of what a modern house should look like in the tropics.

The four tasks brought the subsidies that converged on the three chapters that structure this report:

1 The Casa de Vidro, the Bardi Couple and the Bardi Institute: History and Significance

It organizes and presents the research developed by task group 1 and the coordination in five items:

- The project of the Bardi couple in Brazil: from cultural action to the construction of their own history – seeks to elucidate the role of the couple Lina Bo and Pietro M. Bardi in the Brazilian historical-cultural and political process, identifying their legacy and the mission of the Institute they founded before dying.

- The Casa de Vidro: a site of continuous experimentation – presents in detail the history of the house, its construction and transformation to the present day. It relies on in-depth documentary research in the Bardi Institute and several other institutions.

- The Casa de Vidro: architecture, art and nature – launches hypothesis of interpretation of the role of the garden in the expographic and architectural conception of the couple Bardi.

- The Bardi Institute and the Casa de Vidro - from the documents used in the process of declaring the Casa de Vidro a heritage site and the foundation of the Institute, it tells the history of the institution and reflects on the possibilities of use of the house.

2 Inventory and recommendations for conservation

A synthesis of the four tasks, the inventory presents the surveys, diagnoses, pathologies and guidelines for maintenance and restoration interventions. The inventory was organized by building, with a special section devoted to landscaping.

The part related to the buildings shows the main highlights:

- Main House: The analysis of the structure attests to the good condition of the reinforced concrete and its ability to withstand the new use of the house as a publicly accessible institution (Annex 2: Structural Report). The study of the causes of constant glass breakage points to different displacements of the slabs by thermal expansion, alteration of the glazing pockets geometry by oxidation and impact of tree branches, resulting in urgent intervention guidelines for its preservation. Roof leaks constitute the other urgency, which demands changing tiles, eliminating fiber cement tiles and correcting storm water system defects. Other interventions are mostly routine maintenance, use adjustments, or removal of alterations to rescue the original form. It is noteworthy the use of the method of cathodic protection against the oxidation of the glazing pockets with zinc sacrificial anode (Annex 3: Glazing Pockets and Glazing Report).

- Studio: The assessment indicates a good state of conservation, which requires only regular maintenance, and assesses the building as suitable for new uses, such as courses, lectures and workshops.

- Garage: Indicates a good overall condition, alerting for the urgent need to remove trees that have grown spontaneously in the garden slab. It also identifies a structural arrow in the gate, when opened, which requires its replacement by a lighter model.

- Caretaker's House: The evaluation points to the infiltration originating from the garden cover and the wall in contact with the soil as the main problem, giving indications for its correction. And reveals the potentiality of changes of its interior for new uses.

- Landscaping: A garden-specific inventory of vegetation surveys associated with building conflicts (retaining walls, walls, paths, etc.) has the main highlights:

  - Inventory of built components: Retaining walls, garden walls, paths, stairs, ramps, rainwater reservoirs, floors and living spaces. Points out required routine maintenance locations and exceptional intervention situations.

  - Arboreal management plan: Urgency item in the Plan of Management and Conservation due to the risk to buildings, garden environments and, on the street, to the public power grid. It proposes pruning and suppression of 159 tree individuals in a set of 832 that make up the garden.

  - Visiting Paths and Areas of Support: Evaluates the difficulty and points of interest of the paths through the existing paths, selecting a set of 43 remarkable trees to receive didactic identification.

  - Ramps and stairs: Evaluation of the slope conditions, their accessibility classification and recommendations.

3 Conservation Management Plan

The plan feeds a conservation policy of the Casa de Vidro related to institutional recommendations on the Bardi Institute, responsible for its management. The plan consists of:

- Declaration of Significance: Indicates the value of the Casa de Vidro aesthetic exceptionality amidst the modern Brazilian architecture, pointing out the importance of the glazed room and its slender structure for the integration with the tropical garden in which it is inserted. It defines the role of annexes in constructing a narrative of the transformations that architect Lina Bo Bardi undergoes throughout her life. It establishes the historical importance of the house as a residence of the Bardi couple, where they lived and where their collection of works of art and their documentary collection are housed. It also points out the role of the House, listed in the three levels – municipal, state and federal –, as a reference for the preservation of the collection and architecture. Finally, it highlights the Bardi Institute's mission of cultural formation in the field of the arts, considering it inseparable from the preservation of the Casa de Vidro.

- Matrix of Significance: Based on the researches, it attributes aesthetic and historical value, as well as authenticity, degree of irreplaceability and general meaning to the main components of the complex that makes up the Casa de Vidro.

- Goals Plan: establishes six goals for management and conservation policy, structured into goals, actions and projects:

  - Goal 1 – Preserve the modern aesthetic integrity of the Casa de Vidro as an example that stands out in amidst the vast array of modern architecture produced in Brazil in the 1950s.

  - Goal 2 – Preserve the attached buildings (Caretaker's House, Garage and Studio) as testimony of the transformations in the architectural and cultural conception of the Bardi couple.

  - Goal 3 – Make the garden enjoyable for visitors, seeing it not just as a complement to architecture.

  - Goal 4 – Institutional: Consolidate its use as a house museum, headquarters of the Bardi Institute, with a significant collection, consisting of the personal documents of the couple Lina and Pietro Maria Bardi, and their collection of works of art.

  - Goal 5 – Plan new buildings and expand the urban / social insertion of the Casa de Vidro.

  - Goal 6 – Provide the Casa de Vidro with adequate facilities, infrastructure and routines for its use as a cultural institution and its status as a listed historical heritage site.

- Summary of Projects and Phases: Sorts out the goals plan projects in order of priority, presenting the necessary referrals and indicating their situation regarding the source of resources for their execution.

- Master Plan: A plan that outlines the need for new constructions on the property and the guidelines for urban integration with the neighborhood and region its. It's composed by:

  - Guidelines for the Expansion of the Institute: Stairway and Ramp, to give universal accessibility to all buildings (Goal 6). Proposed location of new toilets and water tank (Goal 6). Proposed area for expansion of the Bardi Institute (Goal 5).

  - Guidelines for urban integration (neighborhood and municipality): Urban Insertion Plan near the immediate neighborhood: Carlos Drummond de Andrade Square, Valeria P. Cirell House and Morumbi Chapel (Goal 5). Situation map of the Casa de Vidro in São Paulo. Reference to the limits of the urban area when it was built and nowadays (Goal 5).

4 Plan Production Process

- Stakeholders for the preservation of the Casa de Vidro: presents the main interlocutors interested in the conservation of the Casa de Vidro during the production of the plan. It presents a transcript of the main debate with guests, held at the Casa de Vidro Studio in 2018.

- Structure Report: complete report by engineer Ricardo Bento on the structural capacity of the Casa de Vidro.

- Glazing Pockets Report: complete report by engineer Osny Ferreira on the pathologies that produce the breakage of the living room glass, with indications for its correction.

- Casa de Vidro Cloud of Points and information processing: presentation of the process of incorporating the cloud of points, generated by laser scanning, in the elaboration of the Casa de Vidro and its attachments' HBIM models.

- Documenting Modernist Architecture to Learn from the Masters: Describes the laser scanning methodology applied to the Casa de Vidro, compared to Oscar Niemeyer's Canoas House.

1 Introduction

1.1 Reflections on the KIM Program / Getty Foundation projects in Brazil

Beatriz Mugayar Kühl

Opening Remarks

Four Brazilian proposals were selected for grants under the Getty Foundation's Keeping It Modern program, which has awarded 54 projects worldwide to date. The program was launched in 2014 and is expected to run through to 2020. It is designed to finance in-depth research into 20th-century works of outstanding architectural significance. The idea is to offer grants to fund the creation of conservation management plans that steer long-term maintenance policies and set new paradigms for the conservation of the period's architecture. A library of the technical reports on these projects is gradually growing[1], and will undoubtedly prove a crucially important means of exchanging references and experiences on the theme.

The program is an initiative of the utmost importance, as there is a dearth of systematic research on how to conserve these works. Brazil is privileged to have received grants for the study of four modern buildings: the premises of the University of São Paulo's Faculty of Architecture and Urbanism (awarded in 2015), designed by João Batista Vilanova Artigas and Carlos Cascaldi; the Oswaldo Cruz Foundation's Arthur Neiva Pavilion, designed by Jorge Ferreira, in Rio de Janeiro (awarded in 2015); the Casa de Vidro (Glass House), which the architect Lina Bo Bardi designed as her own residence in São Paulo (awarded in 2016); and the Assis Chateaubriand São Paulo Museum of Art (MASP), also by Lina Bo Bardi (awarded in 2017).

First and foremost, suffice it to say that the Getty initiative has enabled something hitherto impossible on this scale when it comes to 20th-century architecture in Brazil: systematic, in-depth research on modern works, their documentation, configuration and present state of repair, the materials and systems used to build them, and the pathologies to which they are prone, all with a view to ensuring their adequate preservation. Though these are famous works amply covered in the historiography on Brazilian modern architecture, none had ever been subjected to this level of cognitive examination, and this has yielded numerous historiographical clarifications.

The Getty Foundation's importance and the fact that the proponent institutions are the stewards of these landmark buildings means a deeper awareness can be garnered and better paradigms adopted for when and how to take planned, tailored measures rather than impromptu and often emergency spot repairs in the light of suddenly manifested pathologies. The intention here is to use the research findings to understand the underlying problems so that preventive, scheduled, considered conservation steps can be taken to boost the performance of their various systems. This change of approach requires studies, planning, constant monitoring and long-term structured actions.

The Getty Foundation thus provides the means for a crucial first phase: the basal research upon which these action plans will be grounded. Specificities notwithstanding, the proponents who undertake this research have to shoulder the responsibility to fight—no other word quite covers it— for the conditions to ensure that the plans are implemented and carried through. Specific foci were selected for each work in response to their characteristics, grant size, team makeup, and timeframe, and there are numerous issues that will need to be addressed in the future if sufficiently scoped conservation management plans are to be achieved.

Figure 1
Oswaldo Cruz Foundation, Arthur Neiva Pavilion, architect Jorge Ferreira, 1942, Rio de Janeiro. Photo: Glauber Gonçalves.

The importance of maintenance and preventive conservation

Down through the millennia, ongoing maintenance has always been the most effective way of ensuring a building's survival and keeping depreciation and repair costs to a minimum. The treatises have said as much since at least Vitruvius, roundly seconded by Alberti, who drew parallels with medicine and declared that the best way to treat an ailment was to understand its underlying causes.[2] This type of approach was echoed in successive treatises by various different authors. As Giovanni Carbonara (1992, p. 41) recalls, constant maintenance is assimilated into preventive medicine with a view to avoiding or postponing the need for more drastic and traumatic intervention, such as surgery. This was already clear to John Ruskin in the mid 19th Century:

"Take proper care of your monuments, and you will not need to restore them. A few sheets of lead put in time upon the roof, a few dead leaves and sticks swept in time out of a water-course, will save both roof and wall from ruin. Watch an old building with an anxious care; guard it as best you may, and at any cost from every influence of dilapidation. [...]; and do this tenderly, and reverently, and continually, and many a generation will still be born and pass away beneath its shadow" (RUSKIN, Create Space Independent Publishing Platform, 2016, p. 117)

The need for maintenance has been reaffirmed countless times over the centuries, even in international charters and recommendations, such as the Athens Charter for the Restoration of Historic Monuments (1931), Article 1 of which urges for: "regular and permanent maintenance to ensure the appropriate conservation of buildings"— something reiterated in Article 4 of the Venice Charter of 1964, "It is essential to the conservation of monuments that they be maintained on a permanent basis".

Constant conservation became a broader topic in the 20th Century, with Cesare Brandi[3] coining the term "preventive restoration" in 1956. The author argues that the expression should not be taken to mean that one can vaccinate a work against the ravages of time, but rather that "through stewardship, carefully removing dangers and ensuring favorable conditions" (BRANDI 2004, p. 99), more urgent restorations can be avoided. Brandi's notion of prevention goes beyond the strict material sense of the work to include how it is inserted within its environment. This theme drew even greater attention in Italy after the Florence flood of 1966, which very dramatically recalled the connection between the monument and its environment, a perception echoed in the voices of various authors. In the decade that followed the theme reverberated on an even wider scale, with Giovanni Urbani's 1975 Pilot Plan for the Programmed Conservation of Cultural Heritage in Umbria (URBANI, 2000, p. 103-112; BASILE, 2004). Through an articulate and complex formulation that goes from the training of the various professionals involved to proposals for urban and territorial-wide stewardship, Urbani broaches cultural assets as territorially rooted, and favors regular, continual conservational interventions directed at whole contexts over exceptional remedial measures applied to isolated landmarks.

As Claudia Carvalho (2014) notes, the issue gained weight in the international debate from the 1990s on, catalyzed by the museums and the conservation of archives and estates, which required concerted action in climate and pest control, etc., later consolidating as risk management. An understanding that the conservation of collections depends on their interactions with the buildings that house them, many of which are themselves key preservation targets, broadened the discussion and attempts to establish a methodology, as can be seen from Getty Conservation Institute (GCI) proposals, which have been working in that direction for decades[4].

In the meantime, preventive conservation in the field of architecture continued to mature, not only in the Italian proposals arising since the 50s, but also, as Carvalho (2014, p. 145) shows, in Dutch experiences from the 70s onwards, which proposed constant and periodical maintenance actions that successfully staved off more drastic and expensive invasive restorations, leading to important savings. Many more cases followed, such as those occurring in Belgium after 1991, in the UK in 1999, and in Spain in 2015, with the publication of the Spanish National Plan for Preventive Conservation. The plan was buoyed by the recommendations issued by a scientific congress held in Vantaa, Finland, in 2000, with a view to devising a preventive conservation strategy for Europe. The Vantaa gathering was supported by numerous institutions, including the International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM), an intergovernmental organization in the service of the UN. ICCROM has been developing numerous activities related to preventive conservation, including risk management, such as courses and workshops and draft directives (ICCROM; CCI, 2017). Of particular importance at ICCROM is Gaël de Guichen's[5] pioneering work in preventive conservation, and that of José Luiz Pedersoli in risk management. There is a UNESCO chair devoted to the theme – PRECOMOS[6] – coordinated by Koenrad Van Ballen, based at the Raymond Lemaire Centre for Conservation at the Katholieke Universiteit Leuven, in Belgium. Numerous authors have published Pragmatic manuals and best practices on how to devise conservation plans. Notable examples are Australian author James Stemple Kerr's pioneering *The Conservation Plan*, first published in 1982[7], and Icomos-Australia's Burra Charter, especially from the 1999 edition on.

In Brazil, there have been many projects in this direction, some of the most pioneering and longest-lasting deserve special mention, starting with Claudia Carvalho (2014, p. 147-48) and her 1994 Preventive Conservation Project for Libraries and Archives, followed by another milestone in the area, her work at the Museu de Arte Sacra (Museum of Sacred Art) in Salvador in 1998, for the Federal University of Bahia (UFBA), an integrated project that involved conservators and architects from the Federal Universities of Bahia and Minas Gerais, Fundação Vitae and the GCI.

The Museum of Sacred Art project generated further partnerships with the GCI and Fundação Vitae, such as Alternative Climate Control for Historic Buildings (2003-2010)[8], under the enormously competent coordination of Shin Maekawa and Gina Gomes Machado (both GCI), with Franciza Toleda (Vitae) in a consulting role. The project encompassed actions at the Museu Paraense Emílio Goeldi (Emílio Goeldi Museum of Pará), in Belém (Lucia Hussak van Velthem, curator; Algria Celia Benchimol, technician; Rosa Arraes, conservator) and the Fundação Casa de Rui Barbosa, Rio de Janeiro (Ana Pessoa, director; Claudia S. Rodrigues de Carvalho, architect in charge). In 2001, this partnership held the symposium "Taller Edificios de Museos y sus Colecciones - un proyecto del Consorcio latinoamericano de formación en conservación preventiva" at the Centro de Conservação e Restauração de Bens Culturais Móveis—UFMG (UFMG Center for the Conservation and Restoration of Cultural Estates), with the participation of Brazilian and Latin American professionals from museums, conservation centers and universities. Since the 2000s, preventive conservation has also featured on the curricula of undergraduate and postgraduate courses at a wide variety of institutions. Under the auspices of the National Heritage Protection Institute (IPHAN) and the Monumenta Program, the year 2000 saw the publication of a preventive conservation manual for buildings coauthored by Griselda Pinheiro Klüppel, formerly with the Museu de Arte Sacra project, and Mariely Cabral de Santana, both from UFBA.

Figure 2
Gable restoration works, 2013. University of São Paulo, Faculty of Architecture and Urbanism, architect João Batista Vilanova Artigas, 1961 - 1969, São Paulo. Photo: Renato Anelli.

The work underway at Casa de Rui Barbosa, begun in 1998, also warrants special mention. Rigorously conducted by Claudia Carvalho, the research has seen the preventive conservation plan morph through revised and expanded editions. This continual risk management means that priorities can be established and issues addressed in a scheduled, ongoing manner over the long term. The measures taken focused on the roofs, climate control, garden drainage, the garden itself, and the architectonic surfaces, etc.[9] This experience shows that it is not only possible but viable to work in this way, with significant results.

These initiatives clearly evince the need for ongoing, in-depth study of the works and environments on and in which conservation measures will be taken. The approach is akin to preventive medicine, subjecting the works to periodical check-ups to ascertain their general state of health and identify areas for specialist consultation, which can then follow established protocols or opt for experimental approaches in order to reduce the necessity for invasive (surgical) interventions.

This certainly demands research, lengthy periods of results analysis and action planning, all of which requires institutional will. The Keeping It Modern program offers professionals the chance to conduct research and analyses that would be financially impracticable if relying on Brazilian funding alone.

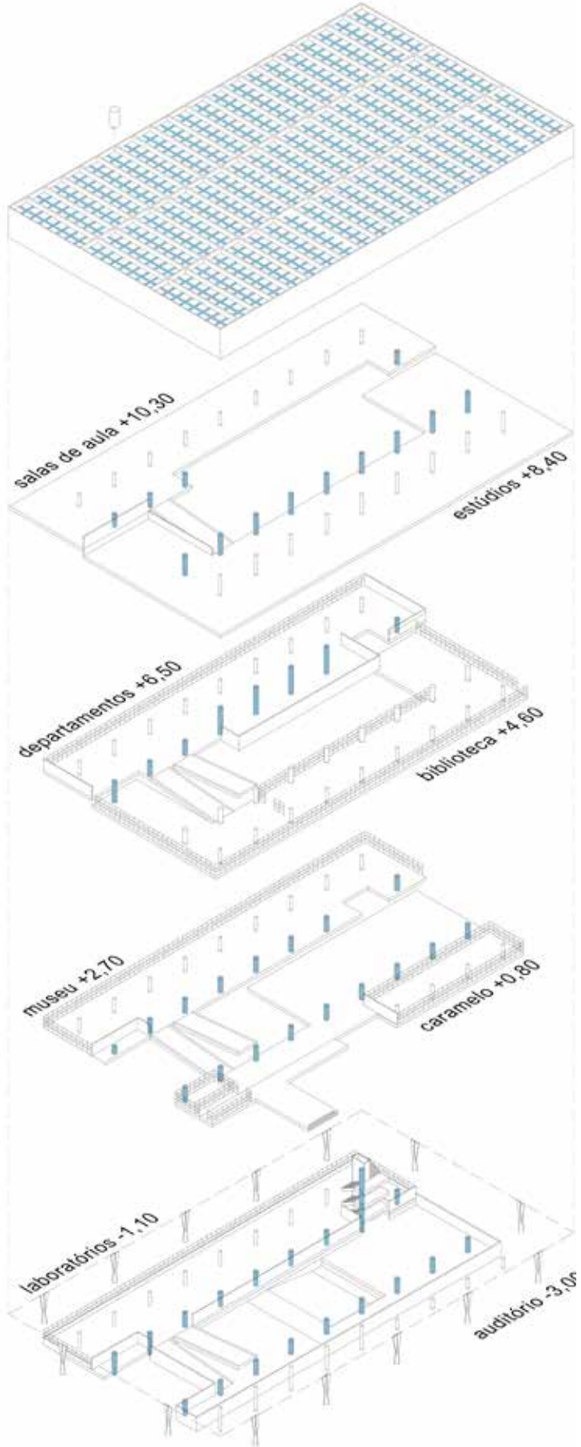

Figure 3
Analytical scheme of rainwater collection in the coverage and distribution of the pipe by the central pillars of the building. Conservation Plan of Vilanova Artigas Building, Faculty of Architecture and Urbanism, 2017.

On issues in architecture maintenance in the 20th Century

One particularly valuable result the Getty program has furnished is that we are beginning to see experimental procedures and protocols for recurrent issues in 20th Century architecture that have not yet been systematically tackled, not only in Brazil, but internationally too. Problems such as those affecting the roof of the USP Faculty of Architecture and Urbanism have cropped up in similar constructions elsewhere and no adequate, appropriately monitored solution as been found. The same could be said in relation to other issues that have arisen out of the funded projects, not least the structural behavior identified at MASP, particularly the problems caused by water seepage, the constant window breakage at the Casa de Vidro, and the popping tiles at the Arthur Neiva Pavilion.

Another topic for reflection is the cause of this lack of structured knowledge of maintenance procedures and of systemized data on the behaviors of certain materials and structural solutions. What has happened to the erstwhile culture of conservation? That's the question posed by Andrea Canziani, Stefano Della Torre and Valentina Minosi (2004). The authors explored the root causes of the lax maintenance that has been so prevalent since the early 20th Century, as measures once assiduously taken have become increasingly sporadic and uncertain. Among the possible explanations, the authors identify the immense quantity and heterogeneity of the interventions that now stock this class of action (maintenance, cure, etc.), the construction

market's incapacity to keep up with the demand through loss of technical knowledge; a lack of systematic study and shortage of instruments that would enable various disciplines to make a concrete difference to construction processes; the dearth of scientific and technical R&D for new maintenance procedures; and an overall incapacity to define maintenance in a satisfyingly over-arching manner. They also mention discontinued worksite methods and significant cultural change related to the idea of modernity, new technologies, materials and reflections on architecture. The authors identified a pair of diverging beliefs, one that saw constructions as open and ephemeral, after Giedion, who, as far back as 1929, claimed that houses had no abiding value in themselves, merely use value; and the other, expressed by people like Breuer, who, in 1934, reminded his readers that we cannot simply change built environments like we change tie (CANZIANI; DELLA TORRE; MINOSI, 2004, p. 11). Associated with this more lasting outlook was the belief that certain materials last forever, such as concrete, aluminum, steel, glass, and ceramic, all considered age-proof. To prove their hypotheses, the authors analyzed various construction treatises. What they found was that both perceptions of modern constructions, as ephemeral and as durable, lead to the same abandonment of the tradition of upkeep and care. The problems arising from this were already palpable in the 1910s, but were swept under the carpet. They became harder to ignore in the 60s, as more aggressive atmospheric conditions took an unmistakable toll on materials old and new. The authors argue for a renewed relationship with the built environment, a return to the ethic of cure and to a mindset that does not pursue abstract perfections but acts upon the reality with the instruments of research and management.

The lack of continual maintenance, the interruption of systematic research that could continue to field knowledge on how constructions behave over time, and the non-existence of consolidated protocols on certain materials and construction systems lead to serious problems. The need for research is an urgent theme. It's not enough to identify pathologies: we have to know what causes them and how they unfold over time. We ought to be well beyond the phase of keeping subjective "state of conservation" files, based solely on the conservator's trained eye—ticking buildings off as good, regular, or poor—, but we're not, because we failed to amass the systemized knowledge and procedures that would take. Without qualifying this information and without knowing how problems arise and play out over time it is impossible to plan adequately. Sometimes it's more important to take action on a building that is still in good condition, but has begun to show incipient signs of some fast-deteriorating pathology, than it is on a place that's in poor but stable shape. Likewise, problems that prove to be recurring have to be tackled at their root causes, not their effects. To do that requires research, monitoring and records over time, something the Keeping It Modern program has afforded since the outset.

Notes on Keeping It Modern projects in Brazil

The projects awarded grants by the Keeping It Modern program in Brazil (see Table 1) chose different approaches, given the characteristics of the buildings in question, the construction materials and systems used, their development over time, present state of repair, institutional factors, prior research and interventions, teams at their disposal, etc. That's exactly right; there is no one-size-fits-all remedy, only rigorous approximation from a shared methodological base and accumulated knowledge on the theme. The drafting of the proposal and the execution of the conservation management plan are site-specific, due to all the factors listed above, and one more: their respective Declarations of Importance, understood as the result of a thorough examination of the site and its material, shape and terrain, and changes over time, analyzed in a wide-ranging manner. A lot more has to go into it than a cursory glance just to fill in a blank space on a form. In thesis, the Declaration of Importance is part of the development methodology, and the plan has to be applicable, so it is crucial that this Declaration be approached as the complex procedure which it is, fruit of a snapshot vision of the asset at a given time and formed in tandem with the plan's goals. In short, it should be the summary of an ample, multidisciplinary research process.

Arthur Neiva Pavilion
Oswaldo Cruz Foundation
Jorge Ferreira architect, 1942

Keeping It Modern 2015
Applicant
Sociedade de Promoção da Casa de Oswaldo Cruz

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João Batista Vilanova Artigas and Carlos Cascaldi architects, 1969

Keeping It Modern 2015
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Research Laboratories / Collaborative Firms
Chemical and strength analysis of materials
IPT
Laser 3d scanning/training of local team
DIAPReM Unife
Metric survey
Relevo
Polyurea Tests
SGS do Brasil
Concrete cleaning tests and repair mortars
Pires Giovanetti e Guadia
Tree survey
Podarte

São Paulo Art Museum Assis Chateaubriand (MASP)
Lina Bo Bardi, 1968

Keeping It Modern 2017
Applicant
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Operations and Finance Director (2018)
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Figure 4
Construction of the São Paulo Art Museum, architect Lina Bo Bardi, 1957 - 1969, São Paulo. Source: IB. Photo: Hans Gunter Flieg, 1968.

In the case of the Arthur Neiva Pavilion at the Oswaldo Cruz Foundation, designed by Jorge Ferreira and built in the 1940s, the first step was to assess signs of pathologies, especially seepage, crumbling plaster, and cracks in the tile mural by Burle Marx. Based on the findings of this preliminary assessment, the project was structured as follows: characterization; diagnostics; identification of the causes; procedures and strategies. Thanks to the Getty program it was possible to conduct articulated actions, covering an updating of the basemaps, mapping of the damage to the façade, pictorial research, structural assessment, specific consultancy on damage to the tile mural, and research on Burle Marx's landscape design. With the data obtained and systemized, it was possible to release partial and then final results, develop heritage-education activities to underscore the value of these assets, and plan the next steps, which included risk assessment and the procedures and strategies to be adopted. The aim is that these research activities should be integrated into a broader preventive conservation plan, engaging the various institutional agents responsible for taking care of the FIOCRUZ Institute's cultural heritage (see AGUIAR; CARCERI, 2017).

Of all the grant-receivers, FIOCRUZ is perhaps the one whose management structure is best versed in tackling preventive conservation issues, given its experience in preserving a vast and extremely varied institutional collection and the fact that the Oswaldo Cruz House Heritage Department has been up and running since 1989, tending to the organization's architectonic, urbanistic and archeological assets. In other words, it already has an institutional design for conservation research and management in place, with a proven track record stretching back decades. This structure is not found at similar maturity levels at the other institutions, though these do have maintenance crews and an architecture sector, even if they are not articulated with a research structure tooled for preservation.

In the case of the FAU-USP building on the University of São Paulo campus (built between 1966 and 1969) and designed by Vilanova Artigas and Carlos Cascaldi, the aim was not to create a complete preventive conservation plan, but to conduct research to underpin one in the future (PINHEIRO et AL., 2017). Two main fronts were chosen: first, to control and manage the building's most constant agent of degradation (water); and, second, carry out studies to determine the effects of repair work to the concrete gables in 2014, which detracted from its uniformity. The building's brutalist overhang always proudly wore the traces of its construction, but there was always a oneness to it, something that was lost after the patchwork renovation. The focus of the proposal was the effectiveness of the building's protective elements: the roof (Task 2) and overhang (Task 3). However, it was understood that the treatment of these features was closely related with the ways the building has been perceived and apprehended over time (Task 1). As such, Task 1 strove to systematize archive material, study the bibliography, and document the transformations and forms of spatial appropriation, organizing data and studying the records. The idea was not to create an archive or merely apposition the elements, but rather to carry out analyses on the spatial characteristics and proposed directives for the use and treatment of the spaces, respecting their compositional traits, understood as an asset to be preserved in order to ensure that the building is seen as its creators intended it to be. With regard to the roof, one of the main concerns was to verify its performance since the completion of the restoration work in 2014. In addition to various analyses—including a thorough and precise examination of the structural deformities—one of the partial results was the creation of a monitoring and management plan that established periodicity and methodologies for inspection, cleaning and conservation work, and outlined some targeted waterproofing repairs suited to the techniques used on the last intervention and to the proposed performance levels. The issues related to the overhang are complex, as the studies conducted during the Getty project identified the inefficiency of the repairs performed, revealing cracks, shedding, and exposed formwork, compromising structural performance and protection against corrosion. Laser scans were carried out to obtain the precise geometry of the overhang, check for deformities, and obtain more precise diagnoses of pathological manifestations. On the areas where concrete patches had fallen off, attempts were made to obtain more satisfactory results formally and structurally, but without conclusive results. That said, premisses were established for future developments.

Lina Bo Bardi's Casa de Vidro, designed and built between 1950 and 1952, is described in detail in this volume, but suffice it to say here that it, too, involved a process of gathering and systemizing historical documentation, articulated transversally with the other work fronts, including a thorough appraisal of the present state of the building and its grounds (using traditional survey methodologies, 3D laser modeling and BIM, etc.), the precise examination of the existing constructed area, a tree survey and landscape studies. These last-mentioned measures were adopted because the building/landscape relationship is essential to the complex and the gardens are important in their own right and so require specific directives. The plan is structured as follows: declaration of importance; diagnostics and inventory; conservation plan geared towards material interventions, and an institutional management plan for conservation.

From the very start, the MASP project was the one that established objectives specifically and mainly concerning the structure and its functioning, as preliminary evaluations found these to be the priority areas. The documental research that underpins the proposal was therefore conducted with two key objectives in mind: (a) to establish a declaration of importance; and (b) subject the structure to more rigorous examination, spanning both its construction and any interventions that have been made to it over the years. The documental research was associated with two other interconnected fronts: the conservation of the concrete; and the structural behavior of the building, including modeling to ascertain how the structure was designed to function (the original calculations) and how it actually functions today. This allowed the team to identify the most urgent vulnerabilities, suggest ways to address them, and provide data for a proposed conservation policy that includes periodical monitoring and an action plan for tackling the most pressing problems. The proposal is that this initial kernel expands into a full conservation management plan in the future.

Concluding remarks

These four cases covered by the Keeping It Modern Program in Brazil were essential to consolidating or inculcating an awareness of the need for conservation management plans based on in-depth research. Each of the institutions has a different design for absorbing the dynamics that surround the drafting of such a plan: FIOCRUZ has the most robust structure, while FAUUSP, Casa de Vidro and MASP have architecture and maintenance departments that are better equipped to handle the daily demands, but are not operationally linked with conservation or research departments. A public organization like FIOCRUZ, FAUUSP is an educational institution whose syllabus includes conservation themes, yet it had never systematically directed its expertise into conserving its own buildings. All of the institutions involved have maintenance routines, but these are generally remedial, impromptu and unshored by specific research, systemized knowledge, constant monitoring and a sufficient budget. The Keeping It Modern experience was of the utmost importance on numerous fronts, one of which was instilling a long-term conservation-mindset. Scientific output on the theme reveals that scheduled, periodical preventive conservation costs less than major sporadic interventions and is far more efficient in respecting the material, structural and documental aspects of the building by requiring less invasive measures.

Though these are all widely studied constructions, the projects on these four cultural assets offer a trove of previously unavailable knowledge on how they were built, how they really function structurally and materially, and about their respective geometries. As such, they provide historiographical clarifications of crucial relevance. The documental and bibliographical research informs the work of other disciplines and vice-versa, leading to reciprocal enrichments and promoting integration between areas, something valued in theory but hard to establish in practice.

The studies on materials and structures were also important in honing the general awareness of the method's analytical and diagnostic applications, as it's not a matter of conducting studies on structures and materials as such, merely to broaden the specific knowledge base about them. As these are buildings of cultural note and import, the research should be pursued in the interests of conservation, and that implies a distinct approach. To return to our comparison with medicine, what we don't want is an autopsy or lesson in anatomy. These buildings must be treated as living organisms, and given regular checkups. Interventions will have to be made, but they should be as mild as possible. We have to do what's needed, but the less invasive that is, the better. With light but constant conservation, we can ensure that these works enjoy a long and dignified existence.

The experience garnered over the course of the Keeping It Modern program was fundamental to ensuring a process of awareness-building about the benefits of conservation management at these institutions, based on research that fosters deeper knowledge about the works in question and which translates into wide-ranging conservation management plans that actually guide institutional practices and serve as a reference—scientific and institutional—for other buildings and their caretakers.

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Notes

1 The reports are available at the Keeping It Modern Report Library on the Getty website: http://www.getty.edu/foundation/initiatives/current/keeping_it_modern/report_library/index.html

2 Alberti, *De re aedificatoria*, X. 1. Cf. JOKILEHTO, 1999, p. 27. The author returns on various occasions to these proposals developed over the centuries.

3 The term appeared in print for the first time in an article from 1956 (BRANDI, 1956), republished in 1963 in Theory of Restoration (BRANDI, 2004, p. 97-109).

4 See, for example, the important book by Kathleen Dardes (1998). The bibliography on the theme in Brazil and abroad is vast. For more on these issues and a preliminary bibliography on the theme, see: CARVALHO, 2014.

5 The author's output is extensive. See, for example, DE GUICHEN, 1999.

6 Based in the Raymond Lemaire International Centre for Conservation – RLICC at the Catholic University of Leuven, Belgium.

7 The first edition was published by the Historic House Trust NSW, Australian Heritage Commission and Commonwealth Department of Housing and Construction. The seventh, revised and updated edition was published by Icomos-Australia in 2013.

8 http://www.getty.edu/conservation/our_projects/science/climate/climate_partners.html

9 For more information visit the institutional website: http://www.casaruibarbosa.gov.br/interna.php?ID_S=23&ID_M=528

1.2 The Casa de Vidro project for the KIM program: structure, process and development.

When preparing the proposal for the KIM program call for 2016, the Bardi Institute chose to establish a collaborative partnership with researchers from the Institute of Architecture and Urbanism of the University of São Paulo IAU USP. Besides being the university institution in which works as professor the architect Renato Anelli, then IB director, the IAU USP presented the conditions of academic knowledge in the area of preservation of historical heritage, landscaping, architectural history, digital design systems and pathology of buildings. The project for the KIM program brought together outstanding professors in these areas, organizing them on four working fronts, which would provide input for the preparation of the Conservation Management Plan.

Named as tasks numbered one through four, the research fronts were structured as follows:

Task 1
: Coordinator Prof. Dr. Aline Coelho Sanches Corato - Historical research on the house and the Bardi couple in primary sources (documents, drawings, photos) and reference bibliography. Systematization of the surveyed documents and elaboration of a historical information base for the other project teams.

Task 2
: Coordination Prof. Dr. Márcio Minto Fabrício - elaboration of digital bases in BIM system, encompassing house, annexes and garden. One of the bases generated was the point cloud made from laser scanning, produced by a team from the Diaprem laboratory at the University of Ferrara, under the coordination of Prof. Dr. Marcello Balzani.

Task 3
: Coordination Prof. Dr. João Adriano Rossignolo - survey of the state of conservation of buildings and preparation of pathology diagnosis, with prevention of corrective actions. Among the objectives of this task was a diagnosis of the capacity of the structure of the main house, produced by the civil engineer Ricardo Couceiro Bento.

Task 4
: Coordination Prof. Dr. Luciana Martins Schenck - survey of the state of conservation of the garden, including paths, garden walls and retaining walls. Preparation of diagnosis, with recommendations for management and maintenance.

The work of the groups gathered for these tasks has converged to an inventory, a usual instrument in the area of preservation of historical heritage in Brazil.

The inventory made from the surveys performed by teams of tasks 3 and 4, use as digital bases of drawings made by team 2 to display the components, their diagnoses and maintenance guidelines.

Thus, the inventory gathers in files the detailed presentation of the Glass House with the intervention proposals that underlie the Conservation Management Plan.

The inventory is a consultation and guidance guide for the preservation management of the Casa de Vidro.

Its structure is divided into:

Main House (CV)
: the main house and its immediate surroundings of external paving.

Studio (ES)
: Studio, built in 1986 to house the team of collaborators who accompanied Lina Bo Bardi in the last phase of her career.

Garage (GA)
: Garage, masonry construction probably completed in 1958 to replace a previously existing lightweight structure.

Caretaker's House (CC)
: Caretaker's dwelling place, built along with the main house.

Landscaping (PA)
: Gathering existing building components in the garden, such as stone pathways, walls, gates, etc.

The components of each of these units are organized according to the classification recommended by ASBEA - Brazilian Association of Architectural Offices:

Structure
: structural system, foundations, pillars, beams, slabs, etc.

Seals
: walls, partitions, etc.

Architecture
: Finishing, Casement, Frames, Roofing, Stairs, Lighting, Interior Architecture, etc.

Hydraulics
: System of hot and cold water, hydraulic systems, water tanks, sewage, etc.

Electrical
: System of electrical power installations, logic, telephony, sockets, lightning protection system, etc.

The inventory sheets were located on general drawings of the Glass House building complex. Thus, the damage maps initially produced are not necessary, since the damage annotations on the surfaces of the built volumes presented little utility, given the characteristics of the property. A relevant aspect in the maps produced from the laser survey refers to the markings of the damaged areas on the masonry surfaces, which noted non-pathological items, such as the humidity of the finishing, irrelevant dirt and small irregularities of whitewashed surfaces. On the other hand, major damage such as malfunctioning of the living room ceiling to floor casements, may have more efficient annotation modes than damage maps.

Landscaping items related to vegetation and garden constructions have been grouped together to clarify project information delivered on larger sheets incompatible with such a presentation.

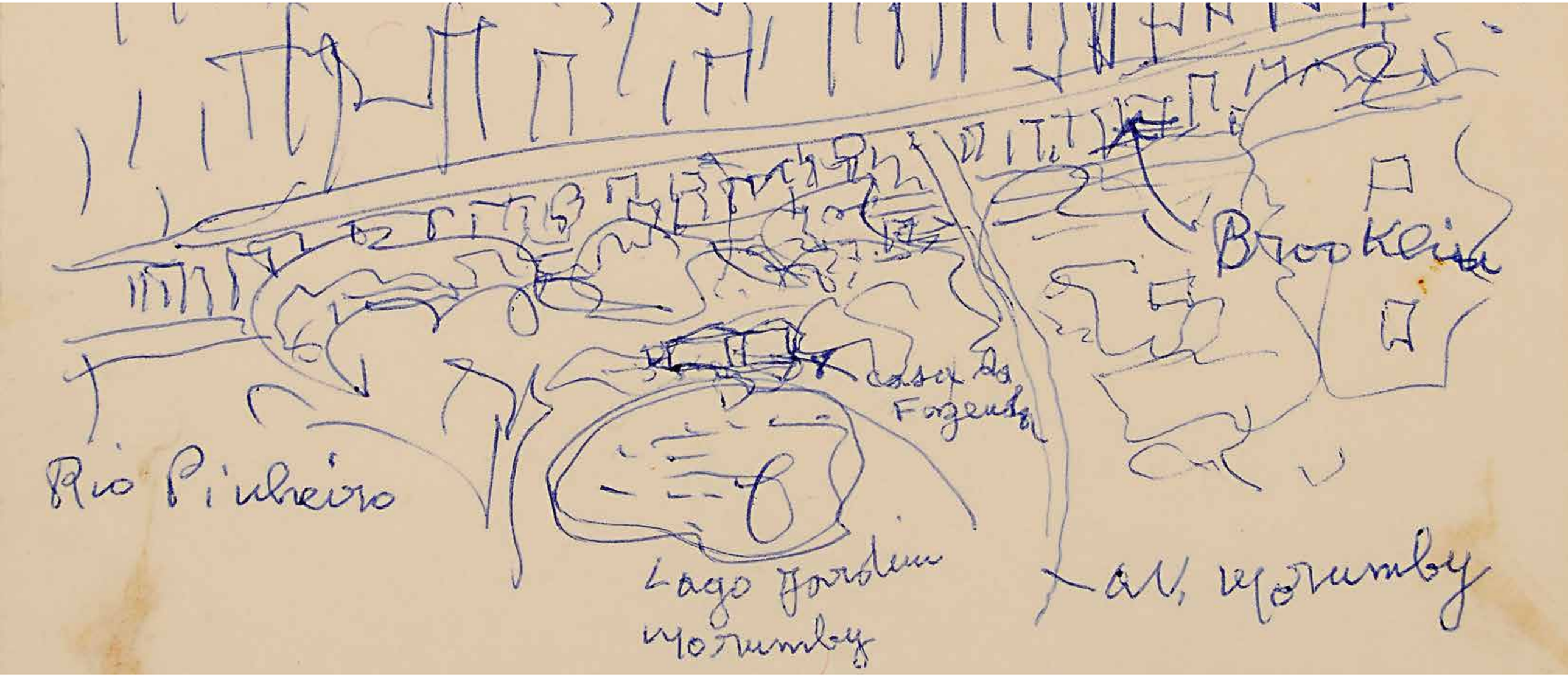
They focus on the management plans of trees (grove) and shrubbery and fodder (understorey). The main guideline is to cut a large number of trees because of the threat posed to buildings and street power, or due to the health of individuals. The tree management plan was detailed, while the understorey management had its guidelines only roughly indicated, as its detailing depends on the openings generated by the previous action. The landscaping team also assessed the condition of garden paths, identifying infrastructures and slopes, suggesting alternatives to ramps and elevator for universal accessibility. Identificaram ainda características da vegetação que permitem a criação de percursos temáticos, classificados por grau de dificuldade ou importância das espécies.

The project, planned to be completed in 18 months, had to be extended. The first extension was until its delivery, on November 30, 2018. It was motivated by the difficulties in synthesizing the products of the four tasks that structured the work. Also contributing to it was the unfamiliarity of the methodology proposed by the KIM program, which was not fully understood by the team until the Getty Foundation workshop in August 2017.

The second extension stems from the need to revise the 2018 report and deepen the plan. It progresses until August 2019, being led by a small team consisting of coordinator Renato Anelli and supervisor Marcelo Suzuki and technical staff, with the support of the original team. The main objectives of this new phase were:

- Review of how to synthesize information gathered and processed in the first phase into a better readable structure and format;
- Deepening the discussion of the Conservation Management Plan proposals with the Bardi Institute Council, considered insufficient in the first phase.

2 The Casa de Vidro, the Bardi Couple and the Bardi Institute: History and Significance

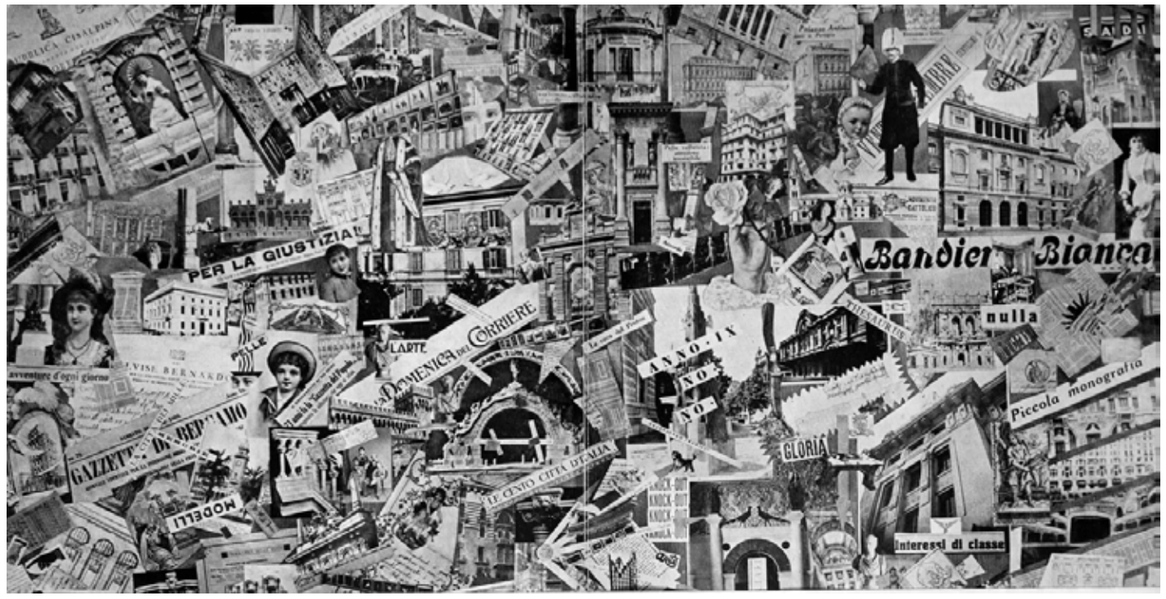


2.1 The Bardi Couple project in Brazil: from cultural action to the construction of their own history

Renato Anelli

Figure 1.
Lina Bo visiting war ruin in Italy. Place, date and author of the photo not identified. Source: IB.. Foto: Federico Patellani

Figure 2.
Tavola degli Orrori, collage made by Fr. M. Bardi for the *Second Italian Exhibition of Rational Architecture*, Rome, 1931.



The Casa de Vidro [Glass House] was the residence of the couple Lina Bo Bardi and Pietro Maria Bardi for about forty years. In it, their trajectories in Brazil are registered, a country to which they made important contributions concerning its modernization process. The first and most acknowledged moment of this trajectory was the creation and direction of the Museum of Art of São Paulo (Masp), conceived as the fulcrum of a project of a modernizing cultural action which, from an art museum, extended to the architecture, design, theater, fashion, advertising, publishing and teaching to play an active role in the process of accelerated industrialization through which the country passed after the end of World War II.

With successes, failures and revaluation revisions, the Bardi couple changed with events: from their engagement in the "developmentalist"[1] project of the 1950s, its exhaustion in the 1970s and culminating, in the 1980s, in its transformation into an active and anticolonialist posture, during the time of Brazil's redemocratization. The international transit of the couple, from Italy and Europe, extending to the United States, Africa, Asia and Latin America, generated peculiar nuances in their interpretation of Brazil and in their propositions regarding the country's directions for its culture, economy and society.

The Casa de Vidro records this history in its architecture, which is transformed by its use and its new constructions, in the garden, which, with the growth of trees, notes the passing of time, on the furniture, objects, works of art that accumulate in the interior of the building, in the library, which makes explicit their intellectual interests.

The couple met in Rome, Italy, in 1943, when Lina, fourteen years younger than Bardi[2], was at the beginning of her career, while he was already an intellectual known for the defense of modern art and architecture.[3] Self-taught, he combined several fronts of work, in magazines and newspapers, with the activities of marchand and director of art galleries.

Bardi's participation in the organization of the *Second Italian Exhibition of Rational Architecture*, held in Rome in 1931, was decisive for the space that modern youngsters would conquer in fascist Italy. Its goal was to dispute the hegemony exercised by Marcello Piacentini, then leading a process of modernization without rupture with the neoclassical academic tradition. Bardi organized a provocative exhibition, opening with a panel of collages that ridiculed the provincialism of Italian architecture, the *Tavola degli Orrori* [Table of Horrors]. During Mussolini's visit to the opening of the exhibition, Bardi presented him the *Rapporto sull'Architettura* [Report on Architecture], a pamphlet in which he argued that rationalist architecture should be adopted as an "art of state", for it was the best expression of the modernizing character of the regime. Despite the negative reaction of the Duce and other authorities to the request, a period of relative acceptance of the modern architecture was opened, which would be victorious in many contests for public projects in the following years.

As a publisher, critic and journalist in Italy, his most successful initiative was the *Quadrante* magazine, that he started in 1933 and which became one of the main vectors of the debate on modernism until its closure in 1936. Thanks to it, he could approach the architects of the vanguards of other countries, mainly for his participation in the IV International Congress of Modern Architecture in 1933. By taking Le Corbusier to give conferences in Rome and Milan in 1934, Bardi consolidated himself as a reference in his country. His combative performance would arouse the attention of young Lina Bo even in her undergraduate years.

Shortly after graduating in the Faculty of Architecture of Rome, in 1939, Lina moved to Milan, starting a partnership with her schoolmate Carlo Pagani. In the midst of the war, with the low activity of the civil construction, she dedicated herself to illustration and interior design projects. Along with Pagani, she collaborated with Gio Ponti for the magazines *Bellezza* and *Lo Stile*, producing covers and illustrations.

With the worsening of the war, Lina followed Pagani in his transfer to *Domus* magazine in 1943. In addition to producing articles more engaged in the proposition of modern architecture, she already anticipated the agenda of the years of reconstruction that would follow the end of the conflict. She started supporting her friends in resisting the German occupation, even if her direct participation in the movement is not proven. In 1945, with the end of the war in Europe, she founded, with Pagani and Bruno Zevi, the magazine *A* – a synthesis of "*Attualità, Architettura, Abitazione, Arte*" – dedicated to presenting reconstruction issues to a non-specialized audience.

Figure 3.
Bardi couple disembarking in São Paulo from Rio de Janeiro, February 26, 1947. Source: IB.

Figure 4.
Museum on Waterfront, architect Lina Bo Bardi, São Vicente, 1951 (not built). Source: IB.

The adherence of Pietro Maria Bardi to fascism is controversial. It is not unlike that of most rationalists who, during the war, would repent and act in opposition to the regime. Recent studies have revealed he was an isolated figure in the bureaucratic political apparatus of the state, a character whose political conception was not accepted by the members of the Fascist Party.[4] The reaction of political sectors of fascism, which did not accept modern art and architecture, led to the closing of *Quadrante* in 1936 and to Bardi's censorship in 1938.

In addition to his editorial activity in magazines, Bardi had experience in directing cultural institutions. He directed the Galleria d'Arte di Roma from 1930 to 1933 and, in 1944, founded the Studio d'Arte Palma, where he developed a program of exhibitions, conferences and training in the area of restoration and attribution of works of art. It was thanks to it that Bardi, newly married to Lina, planned to come to Brazil in September 1946 to present art exhibitions in Rio de Janeiro. In the first of these, held in the Ministry of Education building, a manifesto construction of Brazilian Modern Architecture, Bardi met the millionaire media entrepreneur Assis Chateaubriand, from whom he would receive an invitation to assist in the construction of his museum in São Paulo (Masp).

Bardi brought to Brazil the museological conception that would emerge in Italy after the war, and which animated the museums created in order to occupy palaces and castles restored and adapted for that use. The new way of exposing would also come with the couple. The design of Franco Albini's exhibitions from 1941 in Milan, with its slender and transparent supports, was similar to those created by Lina at Masp's first headquarters. They brought an Italian way of thinking the modern in a country with the presence of remnants of so many different times in art and architecture on the streets of its cities. In the metaphysical art of De Chirico, the central theme was this coexistence between times in the city. For this, light and perspective created a dimension of eternity, beyond any instrumentalization of the classic by the historical present, be it authoritarian or democratic. It was not by chance that Lina's drawings for the Museu à Beira do Oceano [Museum on the Waterfront], made in 1951, used depth and metaphysical light, depicting paintings and sculptures through collages in perspective, with the infinite ocean in the background. An experiment was carried out in the room of the Casa de Vidro and, later, in the transparency of the headquarters of the Masp in the Paulista avenue. Glass easels and transparent facades arranged works of art in the same space and time, suspended over the city, between the green of the Trianon park and the view of the valley.

The Casa de Vidro was an opportunity for experimentation, as Aline Corato develops in her article that follows in this volume.

The role of an art museum in Brazil, however, brought new problems in relation to the Italian experience. The constant presence of Nelson Rockefeller in São Paulo pointed to the Museum of Modern Art (MoMA) of New York as a reference for the new Brazilian museums, among other subjects of interest of the United States government. The opening to the international debate is expressed by Bardi's participation, since 1947, in the International Council of Museums (ICOM), which proposed policies for museums to be aimed at training audiences and artists.

Masp was created with this program, taking into account the enormous potential of the rapid growth of São Paulo's economy and population after the war. In 1950, the creation of the Instituto de Arte Contemporânea (IAC), at Masp, expanded the formative character of the first years, introducing courses such as industrial design (the first one in Brazil), advertising and marketing, fashion, filmmaking and other directly connected to art. As a project of active insertion in the process of modernization and industrialization in

Figure 5.
Furniture and artwork arranged in the living room of the Casa de Vidro with the landscape in the background. Source: IB. Photo: Peter Scheier

Brazil, it was intended to repeat the role of integration with the industry that characterized the German Werkbund in the early twentieth century, from which the avant-garde Bauhaus (1919-1933) emerged.

The specificities of the Brazilian industrialization process, guided by large multinational companies, did not open space for a design practice of its own, and the project would give its first sign of crisis when the industrial design course was closed, in 1953, thanks to the lack of corporate support. The crisis worsened as accusations arose as to the authenticity of works of art of the museum's collection. Due to his political position and the instrumental use he made of the media of his property, Chateaubriand also attracted fierce opposition to the Masp, which extended to Bardi's direction. As a result, in 1953 Bardi started an international tour to some of the world's leading museums, proving, with his prestige, the quality of Masp's collection.

On the other hand, the physical space limits of Masp's first headquarters required alternatives. The first of these was a partnership agreement with the Armando Álvares Penteado Foundation (FAAP), which was building its headquarters with

Figure 8.
Page of *Habitat* magazine featuring the Polish designer Leopold Haar during the course of Industrial Design at the Institute of Contemporary Art of Masp. *Habitat* #5, 1951, p.45.

Figure 7
Pinacotheca of the new headquarters of Masp in Avenida Paulista, architect Lina Bo Bardi, 1957-1969. Source: IB. Photo: Paolo Gasparini, 1970.

Figure 6.
Authorities at the opening of the expansion of Masp, April 1950. Sitting on the ground: Nelson Rockefeller and Assis Chateaubriand, at the left the President of Brazil, Eurico Gaspar Dutra, and Pietro Maria Bardi at the center, standing behind someone else. Published in *Habitat* magazine #1, 1951, p.18. Source: IB.

a neoclassical project by Auguste Perret at Pacaembu neighborhood, in São Paulo. With the failure of this partnership in 1957, Lina would begin to work, the following year, on the project for a new headquarters for Masp in Paulista Avenue, which was inaugurated only in 1968.

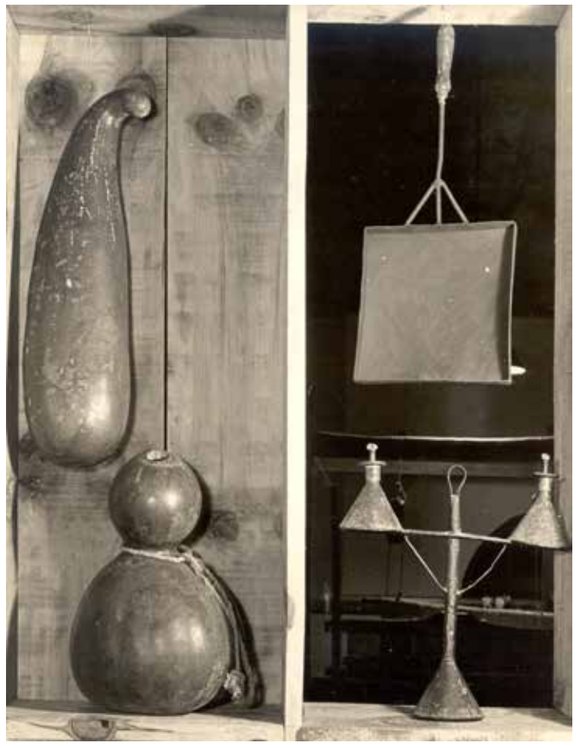
The formative character of the museum carried the risk of Eurocentrism, and the effort made by the couple to avoid it was enormous. The acknowledgement of the Brazilian culture cultivated by them can be followed in the articles published in the *Habitat* magazine, where there was no contrast between their interest in Le Corbusier and in baroque art, or in the ex-Northeastern votes. Popular culture was clearly articulated to the erudite, whether ancient or modern. The museum should be "out of bounds," as Bardi had written at the ICOM Congress in 1947 and reaffirmed in his article for the first issue of *Habitat* magazine in 1951.

In their private library, essential books of "Brazilian thought"[5] present annotations and highlights that have fueled the intellectual transformation of the couple in the decades they lived in Brazil. Works by Gilberto Freyre, Caio Prado Jr., Claude Lévi-Strauss, Celso Furtado and Paulo Freire present, in excerpts, the origins of arguments that support the texts by the couple.


Leopold Haar

Figure 8.
Page of *Habitat* magazine featuring the Polish designer Leopold Haar during the course of Industrial Design at the Institute of Contemporary Art of Masp. *Habitat* #5, 1951, p.45.

Figure 9.
Lina Bo Bardi with Glauber Rocha and film crew of the feature film *Deus e o Diabo na Terra do Sol* [*Black God, White Devil*], 1963. Source: IB.



Figures 10 and 11.
Exhibition Nordeste at Solar do Unhão, which was adapted to be the headquarters of the Museum of Modern Art of Bahia, architect Lina Bo Bardi, 1963. Source IB. Photos: Armin Guthmann.

The transformation of Lina, friend and correspondent to Bruno Zevi, is mediated by her approximation to the organic architecture proposed by him, which makes her make a stop in Barcelona, during her return of a trip to Italy in 1956, just to know the work of Gaudí.

From their first years in the country the couple traveled through Brazil, getting to know different ecosystems, from the humid forests of the Atlantic forest of the coast to the arid landscapes and inhospitable rocky formations of the park of Vila Velha, in Paraná. They, accompanied by Saul Steinberg, visited Roberto Burle Marx's country house in Rio de Janeiro, in 1950, posing for a photo ahead of philodendrons and other plants selected by the landscaper in Brazilian native flora for his gardens. In the same year, Bardi promoted the exhibition *Os Jardins de Burle Marx* [Burle Marx's Gardens] in the Masp, presenting it in an article in *Habitat* magazine (BARDI, 1951).

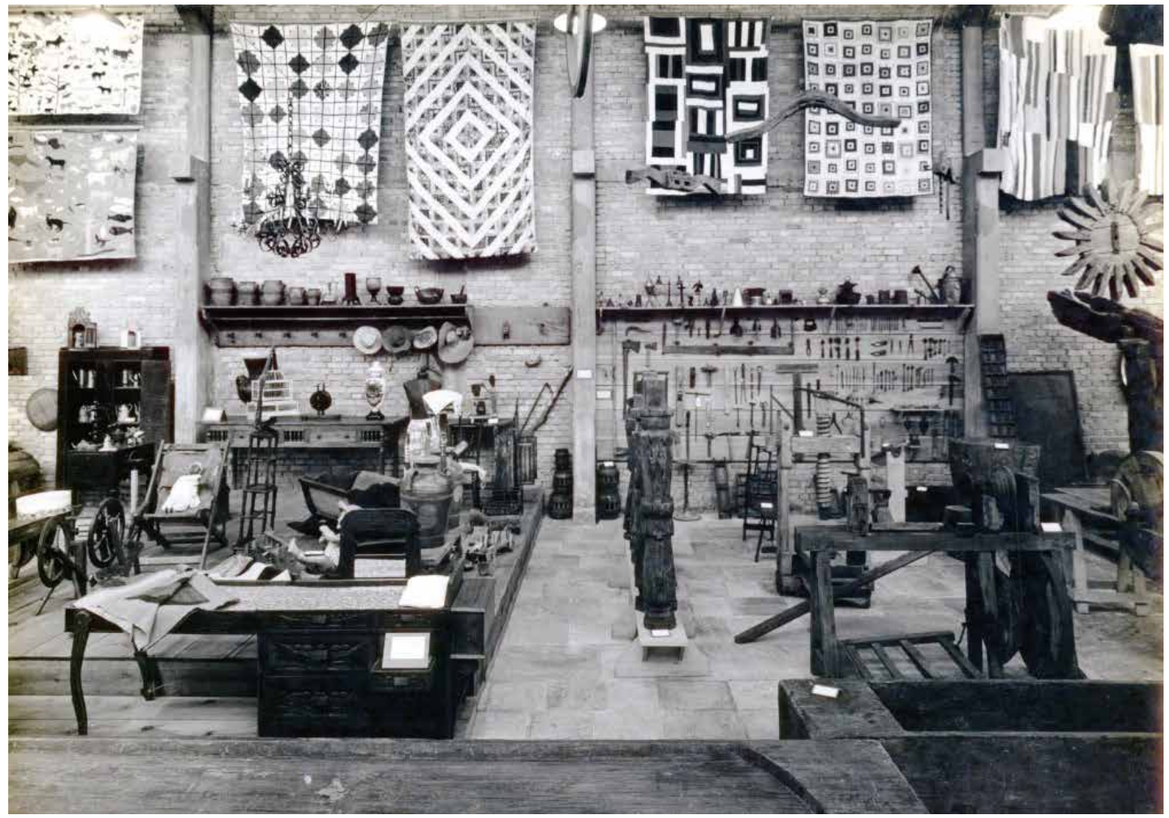
Lina's architecture changed over the years. She designs the garage and the walls of the Casa de Vidro with rustic mortar coverings inlaid with rolled pebbles and compositions of ceramic pieces. On these walls she creates small voids for plants, using species that grow clinging to rocks and ruins.

She uses the same technique in the house of Valeria Cirell, who becomes her neighbor in Morumbi, and, in Bahia, in the Casa do Chame-Chame, both of 1958.

The trip to Salvador, that same year, at first for conferences and then for a course, opened up new perspectives for the architect. There she met European intellectuals, hired as teachers of the University of Bahia, who fed a movement of renewal in the music (the German Hans J. Koellreuter and the Swiss Walter Smetak) and in the dance (the Polish Yanka Rudzka), besides Eros Martins Gonçalves, from Recife, who innovated in theater. Glauber Rocha's engagement in film clubs was also important, as it was by then he started making short films before his first feature, *Barravento*, in 1962. She was charmed by the possibilities of the living together of a sophisticated cultural avant-garde and an economic and social reality of underdevelopment. Being the first capital of the colony for two centuries (1549-1763), Salvador kept examples of baroque religious architecture in the midst of large groups of civil architecture buildings from that period, part of which was in ruins. Another strong presence in the city is the population of Afro-Brazilians descended from slaves. Lina learned from intellectuals and local artists the value of this mixed culture, a living example of the theories of sociologist Gilberto Freyre. She sees the possibility of building a renovation of modern architecture, not in the sense of Zevi's organicism, but in the approach to an authentic popular root.

Between 1960 and 1964, she remains in the board of the Museum of Modern Art of Bahia (Mamba), from where she conducted an ethnographic research of the Brazilian Northeast through the *sertão* [back country] of Pernambuco, Ceará and other states of the region. She conceived a museum that had as its goal reproducing, in a smaller scale, Masp's IAC, but inserted in the projects of economic and social development of the Northeast under direction of Celso Furtado. Unlike the industrialization with advanced technology, which occurred in the Southeast, the proposal for the Northeast was the intensive use of abundant and unspecialized labor in workshops with low technology and little need for capital investments. There she started the Centro de Estudos e Trabalho Artesanal (Ceta), where engineers, architects and artisans would develop an industrial design based on the popular knowledge she had found in the regional culture. A knowledge that was based on the ability to survive with the

Figures 12 and 13. Exhibition "O Design no Brasil, história e realidade" at SESC Pompéia, 1982. Source: IB. Photos: Paquito



minimum resources in adverse conditions, producing tools with traditional modes of manual labor juxtaposed to the recycling of garbage of industrialized products.

The research would result in the exhibition *Nordeste*, at the inauguration of the Solar do Unhão, restored in 1963 to become Mamba's headquarters. The restoration of this construction of the seventeenth century and its adaptation to be used as a museum was Lina's first intervention in a heritage site. The interventions followed the principles of Critical Restoration, a theoretical conception of restoration that emerged in Italy after World War II and which was defended by authors such as Cesare Brandi, Roberto Pane, Pietro Gazzola and Renato Bonelli, and was not yet adopted in Brazil at the time (CERAVOLO, 2013).

The restoration carried out by Lina was daring in interventions of demolition and new constructions. The most important of these is the new internal staircase, made of wood and using "wedge and spike" bolting techniques, common in the old wooden wheels of ox carts. The design, however, is abstract geometric, having nothing in common with the figurativeness of popular objects. It establishes her best

synthesis of modern and popular, in a project of political and cultural character with which she tried to renew what she classified as the decadence of the international architecture from the decade of 1960.

Lina transformed the first project implemented in the IAC and in the Masp in the 1950s into something more inserted in the cultural and political debate of the country in the beginning of the 1960s. Bardi, in turn, made a similar approach to the culture of the country, including the folk crafts and the applied arts to the studies of history of Brazilian art and architecture.

Back in São Paulo after the 1964 coup, Lina approaches the theater vanguard of Zé Celso and Flávio Império, while Bardi welcomes the new generations of artists in Masp.

Years later, in 1982, the exhibition *O design no Brasil: balanço e realidade* [Design in Brazil: Balance and Reality], organized by Lina at the recently concluded Sesc Pompeia, brought together a collection of objects and utensils that she had begun to gather in the years she spent in Salvador and which constitute the collections of the Casa de Vidro. To them were added industrial products designed by Brazilian designers, such as cars, computers and airplanes, which were absent from the exhibitions of 1963 and 1969 (*A mão do povo brasileiro* [The hand of the Brazilian people]). Presented with no intention of constituting a synthesis in this exhibition, the cultural project of the Bardi couple recognized the economic and social role of art and architecture, without which these could not be effective in transforming society. In a way, to be known by future generations, this was the project that the couple was based on when they conceived a cultural institution to be headquartered in the Casa de Vidro, which would be preserved. The official recognition of the house with heritage site status took place in 1986, and the foundation of the Institute in 1990.

The Bardi Institute, The Casa de Vidro and its collection form, thus, the center of reference of the historical narrative of the Bardi couple's trajectory.

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Notes

1 In Portuguese, "desenvolvimentista", derived from "desenvolvimentismo" [developmentalism], refers to an economic theory which states that the best way for less developed economies to develop is through fostering a strong and varied internal market and imposing high tariffs on imported goods, therefore forcing the expansion and strengthening of its industrial sector.

2 We have adopted in these texts the use of the surname Bardi to refer only to Pietro Bardi, for being the way the professor was called.

3 There are different accounts of the exact date they met. The year of 1943 is quoted by Lina Bo Bardi in her biographical notes, although the relationship between them became public in 1946 (LIMA, 2013, p.24).

4 Cf. RUSCONI, Paolo, Conferências: "A Invenção de um Personagem – Iconografia e Fortuna de Pietro Maria Bardi nos Primeiros Anos Trinta", and BIROLLI, Zeno, "Bardi, Pound e o Fascismo", in: I Simpósio Internacional Pietro Maria Bardi – Construtor de um Novo Paradigma Cultural. Campinas: IFCH/Unicamp, 2011.

5 "Pensamento brasileiro", literally "Brazilian thought", is the way the first Brazilian theorists of sociology, economy and politics that dedicated themselves to understand Brazilian reality, such as the ones mentioned in the paragraph, are referred to in Brazil.

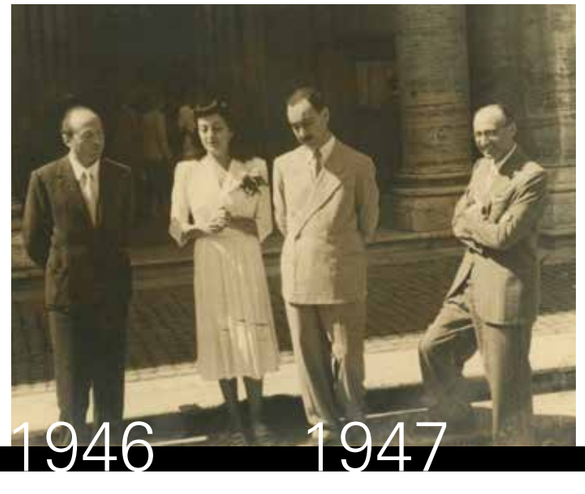
2.2 Casa de Vidro and Bardi Couple's timeline

Bardi Couple's Biographical Timeline

Casa de Vidro Timeline

1946

Lina Bo and Pietro Maria Bardi get married in Italy and make a trip to Brazil, arriving in Rio de Janeiro. Bardi, who comes to Brazil to sell paintings, sculptures and objects of art in South America, meets Assis Chateaubriand, who offers him the opportunity to create a large museum in Brazil.



1947

It is decided that the museum will be created in São Paulo, and the Bardi couple then establish themselves in this city to found and direct the Masp, inaugurated on October 2. The couple initially resides in the neighborhood of Pacaembu.

1948

Creation of the Studio de Arte Palma, which brought together Lina Bo Bardi, Pietro Maria Bardi, Giancarlo Palanti and Valeria Piacentini Cirell.

1949

1950

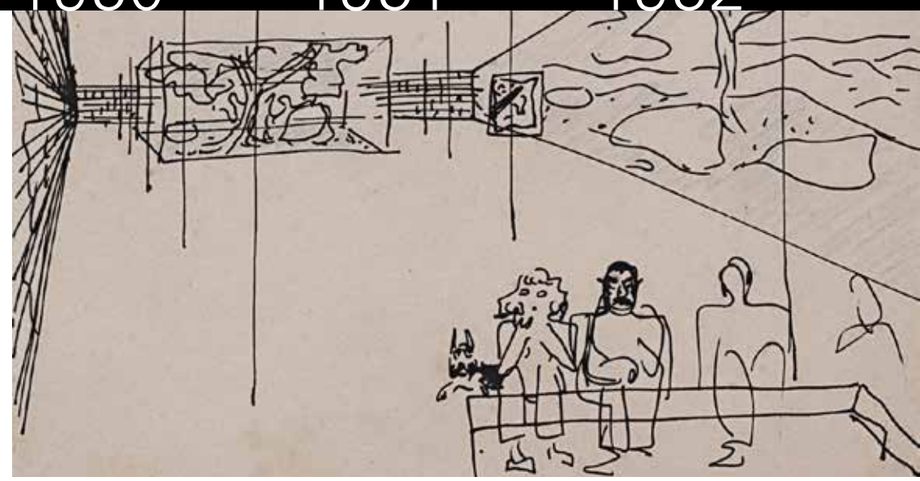
Lina and Palanti designed the expansion of Masp, which houses then the Institute of Contemporary Art. The first issue of *Habitat* magazine is published.

1951

Pietro Maria Bardi becomes a Brazilian citizen

1952

The Bardi couple acquire two plots of land in Morumbi.



Pier Luigi Nervi designs the structure of the Casa de Vidro e from the architectural design of Lina.

Nervi's original Structural Design is adapted by Tulio Stucchi. After receiving the construction permit, the work is started.

The construction of the house is completed, receiving its permit for occupation in November.

1953

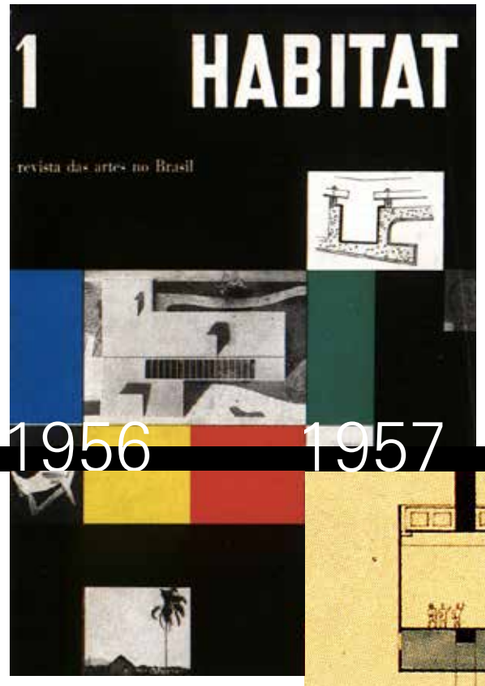
Lina becomes a Brazilian citizen.

The house is called Casa de Vidro [Glass House] and appears in several magazines.

1954

Lina complains about the lack of infrastructure in the neighborhood, and has to live in a hotel.

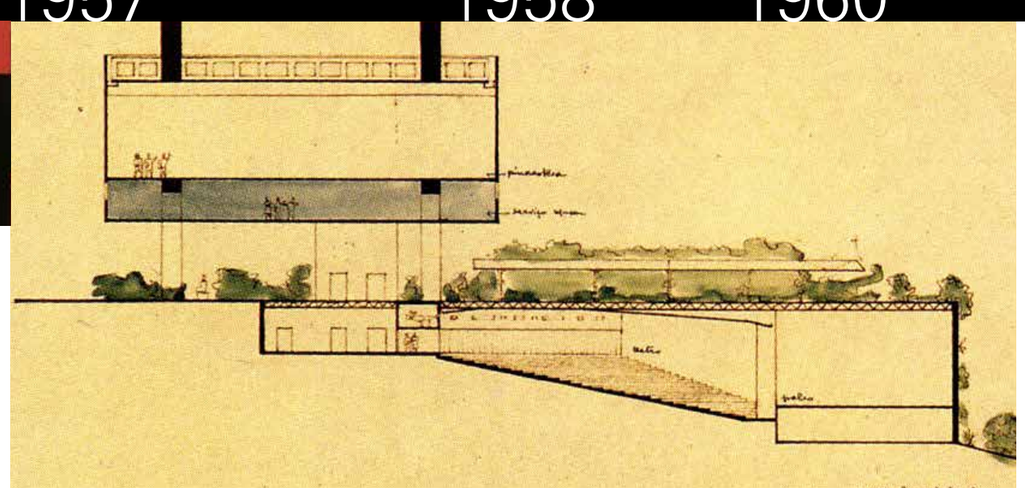
1956



First exchange of broken glass.

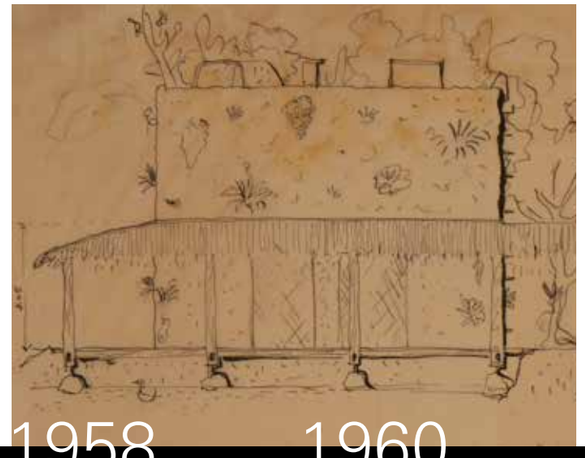
1957

First studies for the headquarters of Masp, on Avenida Paulista, and for the house Valeria Piacentini Cirell, in Morumbi.



1958

The period Lila spent in Salvador, where she gives lectures and courses and designs the Casa do Chame-Chame.



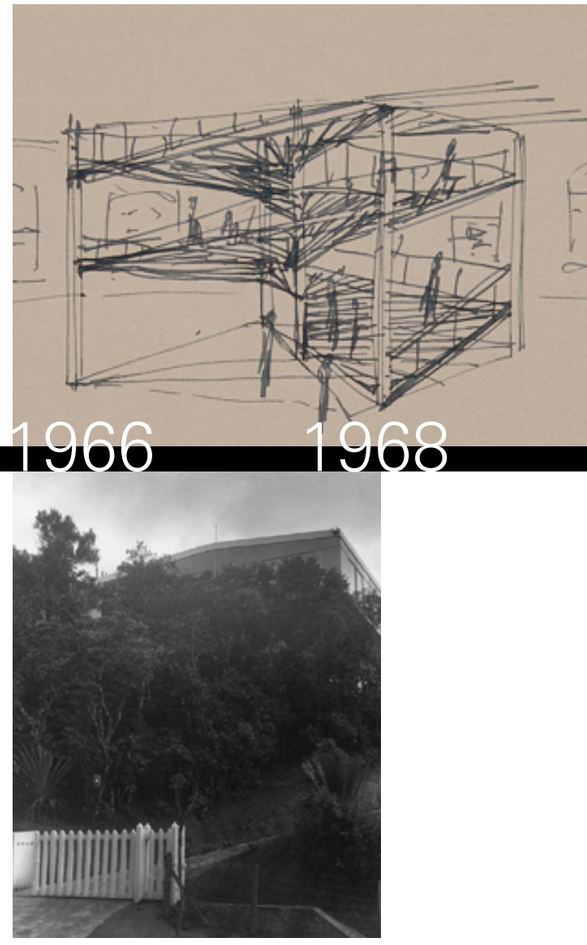
1960

Inauguration of the Museu de Arte Moderna da Bahia (MAMB). Lina remained as the head of the institution until 1964.

The Bardi couple buys the third plot for the house, so the land acquires its current dimensions. Although it is not documented, it is possible that the couple has constructed the new garage and the paths in the garden in that period.

1966

Lina reassumes the accompaniment of the works of the Masp in the Avenida Paulista and Bardi creates Gallery Mirante of the Arts, of which he becomes partner.



1968

Inauguration of Masp's new headquarters.

Lina starts to work on the design of Sesc Pompeia, a landmark work of the latter phase of her career.

1977

Construction of the sidewalk and exterior wall of the Casa de Vidro: roof, lightning rods, gate.

1978

First major renovation in the Casa de Vidro.

1981

1983

Renovation of the glazing pockets and installations.

1986

Condephaat declares the Casa de Vidro a heritage site, after request of the Bardi couple.

The “little house” is built, a studio for Lina’s collaborators.

1987

The handrails of the garden paths are installed, as well as new curtains, while the painting is renovated and the glasses replaced with new ones.

1990

Creation of the Quadrante Institute, current Bardi Institute.

1991

Repairs on the roof and the declaration of the Casa de Vidro as a heritage site by Conpresp.

Lina Bo Bardi dies on March 20. In her memory, Bardi donates to Masp the painting by the Maestro del Bigallo *Our Lady on the Throne with Jesus and Angels*, which the couple kept in their residence. Bardi writes *História do Masp* [History of Masp], published by the Quadrante Institute.

1992

Another renovation of the Casa de Vidro for changing windows, refurbishing the frames, renovation of roofs and floors of the garden, painting and changing of tiles.

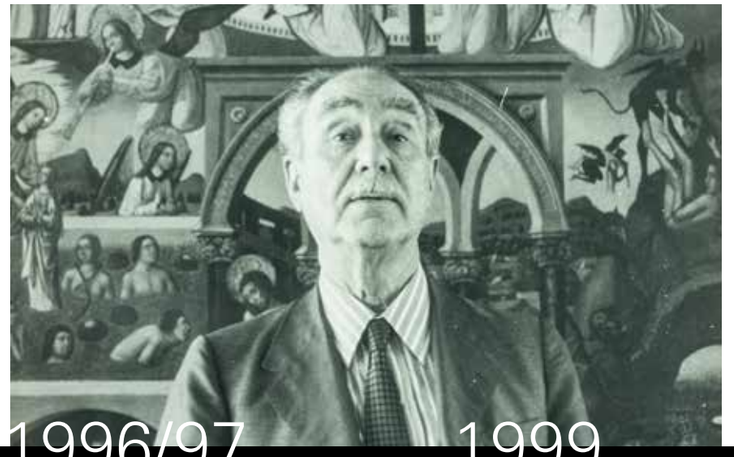
Due to his health condition, Bardi gradually leaves the Masp, from which he had become president of honor. Beginning of the organization of the Casa de Vidro collection; inauguration of an exhibition, a catalog and a documentary about Lina Bo Bardi.

1993

Pietro Maria Bardi donates the Casa de Vidro to the Bardi Institute in order to be its headquarters.

1995

Beginning of contacts with the Institute of Technological Research and Museum of Archeology and Ethnology of USP to eliminate termites both in the residence and outside the house. The interventions are palliative due to the presence of Bardi in the house, when he was already very old and fragile.



1996/97

Pietro Maria Bardi dies on 10 October, and the Bardi Institute is now presided over by Graziella Bo Valentinetti.

1999

Condephaat tomba a Casa de Vidro a pedido do casal Bardi.

Construída a "casinha", estúdio que abriga os colaboradores de Lina.

2000

The centenary of Pietro Maria Bardi is celebrated with the release of a documentary and the publication of the Brazilian version of his biography, authored by Francesco Tentori.

2001

Architect Marcelo Ferraz, collaborator of Lina Bo Bardi, leaves the Bardi Institute.

2006

The visitation to the Casa de Vidro is suspended due to falls of pieces of coating of the slab of pilotis.

2007

The process of termite control in the Casa de Vidro marks the beginning of a new set of renovations and restorations of the glazing pockets, coats, roof, hydraulic installations.

2008

Graziella Bo Valentinetti dies and Giuseppe D'Anna is elected as the new chairman of the Institute.

The organization of the collection progresses under the direction of Anna Carboncini and with the technical work of Malu Villas Boas.

2009

Completion of the maintenance of the floor of the room by Vidrotil.

2013

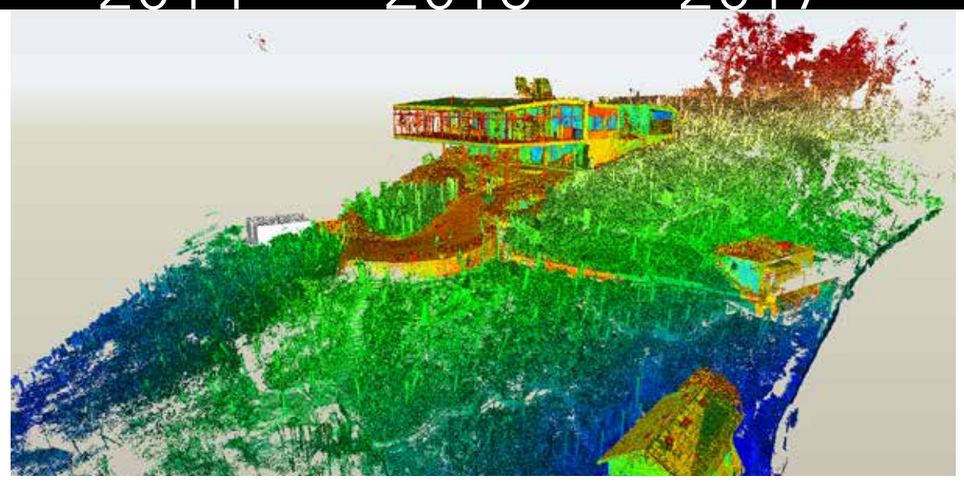
Renovation of the house plumbing installations; restoration of atelier's sliding doors; refurbishment of the wall of support of the caretaker's house.

Site-specific exhibition at the Casa de Vidro, with works by renowned artists and curated by the German Hans Ulrich Olbrist.

2014

Sonia Guarita do Amaral becomes chairwoman of the Bardi Institute.

2016



Research for the development of a preventive conservation plan for the Casa de Vidro is initiated, with funding from the Getty Foundation.

The Bardi Institute is transformed into Social Organization in the area of culture.

2017

Decease of Sonia Guarita do Amaral.

Giuseppe D'Anna elected chairman of the board.

2019

2.3 Casa de Vidro: a site of continuous experimentation

Aline Coelho Sanches

A modern House

The Casas de Vidro [Casa de Vidro] [1], as the headquarters of the Bardi Institute in São Pauli is currently known, is an icon of Modern Architecture. Indeed, this is one of the attributes of the main building in the complex that, for four decades, was the home of an illustrious wife and husband: architect Lina Bo Bardi (1914-1992) and art critic, art dealer and director of the Museum of Art of São Paulo Ð Masp, Pietro Maria Bardi (1900-1999), both of whom were born in Italy and became naturalized Brazilian citizens.

With a project that was initiated in 1949 and construction that was finalized in 1952, the house reflects ideals of form, technique and life propagated by Modern Architecture. Though from the very start, the design created by the architect was conceived of as a hybrid of material representation of faith in technological progress and machines and the material representation of vernacular constructive cultures – just look at the complex's service wing made of ordinary brick and the thatch roof over the first garage. These vernacular characteristics were read from a modern point of view, that is, they came from someone who had, during her formative years in Italy and her early years in Brazil, learned in various ways to appreciate these cultures based on the values of modern rationality, economy and simplicity[2].

Immediately after its construction, the house was also recognized and proclaimed by critics as an exemplary modern model. In 1953, when it was published in "Domus," architect Gio Ponti, director of the important Italian magazine, declared that it had a recognized place in Modern Architecture. In addition, two international books that attempted to narrate the history of this new architecture as well as identify its characteristics, both globally and in Brazil, included the house as their typical example. A photo of its glass facade was featured in Gillo Dorfles's 1954 book *L´Architettura Moderna* in the section dedicated to Brazil and Latin America, and reappeared in print in 1956, accompanied by drawings and images of its interior, in Henrique Ephim Mindlin's *Modern Architecture in Brazil*, which praised the architect's taste for sophisticated details and the vocabulary based on advanced industrial techniques. Faith in new constructive possibilities and their potential to transform spaces and society energized modern architects like Mindlin and Lina, who sought to take advantage of the industrial technologies of mass production and new uses of such materials as glass, steel and reinforced concrete, improved through research developed in laboratories and constructions. At the worksite, this implied a character of experimentation, adjustment to the availability of local materials and a certain boldness. In general, as was the case with the Casa de Vidro, there was a belief that these materials would be permanent, though without certainty of their actual performance, which only time could tell with accuracy.

Almost seventy years after the completion of the House's construction, it is now possible to better understand how those promises were and were not kept. As such, in this essay, I will attempt to present this example of modern architecture and Brazilian cultural heritage with a focus on its construction process. To do so, I will seek to compose a narrative of the complex over the passage of time, from the purchase of the land, through to the project and the worksite, down to the additions and maintenance work, attempting to simultaneously clarify the reasons for the materials chosen and how they have aged. Furthermore, I intend to identify the technical culture mobilized at each moment and the meaning behind it, as well as reveal some of its actors, beyond the author of the architectural project. The narrative's perspective relies on recommendations made by John Summerson in his famous introduction to the study of the History of Construction, published in 1985, in which he sought to pinpoint dual efforts at understanding the works of architecture, both through a comprehension of the design of structures as well as the construction practices employed in them.

The studt's sources and the construction of a hypothesis

To reconstruct this history, I began with primary documentary sources such as drawings, photos, receipts, budgets, letters, notes, accounting books, meeting minutes and others, found in various archives in Brazil and Italy. I interviewed Lina and Pietro's former collaborators and employees at the Bardi Institute[3], in addition to, evidently, studying so-called secondary sources-- namely, articles, books and theses written by notable researchers[4]. In this latter set of interpretations, I did not find any works specifically from the perspective of the History of Construction.

The analysis, systematization and crossing of all these sources enabled the construction of the main hypothesis of this text[5], specifically that the Casa de Vidro was a laboratory for continuous constructive experimentation, invested both in the promises of modern architecture in terms of the use of iron, steel, reinforced concrete, glass and industrialized materials (such as asbestos cement roofing tiles and glass wool), as well as the rational, resourceful employment of traditional techniques and materials such as brick, wood and ceramic roof tiles. Under various circumstances, it was also a locale for experimentation in the conservation of Modern Architecture or confirmation of processes. A description of its history will allow us to demonstrate this hypothesis and an understanding of the aging of the materials can help us consider alternatives for maintenance.

Figure 1
Exterior view of the newly built Casa de Vidro, still with no visible building in the vicinity.
Photo: PMB. Source: IB.

The Bardis, the Casa de Vidro and the promises of a São Paulo in Metropolization

The history of the Casa de Vidro in Morumbi is clearly interconnected with the Bardis' life story, as well as the history of Masp. The connections with the museum were especially strong during the period in which the institution was situated at Rua Sete de Abril, at the time it was founded in October of 1947 by magnate, journalist and politician Assis Chateaubriand, owner of the powerful media conglomerate *Diários Associados*. From the beginning, Masp was under Pietro's direction and Lina contributed heavily to the exhibitions and educational actions, as well as the museum design.

Masp was one of the new cultural institutions created in São Paulo during the period of the city's metropolization, as were such others as the Museum of Modern Art - Mam, the Brazilian Theater of Comedy - Tbc and the Vera Cruz Cinema Company, which counted on the work of a new batch of European professionals who immigrated after the war[6]. Included among them were the Bardis, newlyweds who arrived in Brazil in 1946 without definite plans to stay. Pietro was looking for better opportunities for the Italian art and antique market in Latin America, because of the difficulties in Europe in the aftermath of World War II. He had coordinated a commercial itinerary from inside *Studio d'Arte Palma*, the ambitious Rome gallery that he founded in 1944, and which offered such services as restoration, organization of exhibitions, book publishing, sales and professional expertise[7]. As such, he realized three exhibitions in Rio de Janeiro with the collection brought over on the ship: one of ancient art, another of applied arts and the third of modern Italian art. Historians seem to agree that it was at the first one[8] that Pietro was invited by Chateaubriand to contribute to the founding and direction of the long dreamed-of art museum.

Pietro's life accompanied the entire 20th century. Born in La Spezia, Liguria in 1900, he was self-taught and worked in Rome and Milan as a journalist, gallery owner and art dealer, coming to Brazil as a great expert in European art, both ancient and modern. He was also a prominent figure in the promotion of modern architecture, the author of controversial exhibitions, articles on the theme and responsible, along with writer Massimo Bontempelli, for running an important specialized magazine, "Quadrante." Pietro was a privileged connoisseur of modern ideals, having participated, for example, in the famous Fourth International Congress of Modern Architecture – Ciam in 1933, where he was able to make contact with architect Le Corbusier, whom he so admired. Despite his defense of modern art and architecture, his vision of the lessons of the past and the need to make ancient art present, a theme particular to Italian culture, was committed and ideological and would prove definitive throughout his entire career[9]. It was an idea shared by his young wife Lina, 14 years his junior and who had studied architecture in her hometown of Rome, having earned her degree in 1939. Soon after completing her studies, she moved to Milan, where, along with her classmate Carlo Pagani, she opened an office, which was bombed during World War II. She was also a collaborator at the architectural firm run by renowned architect Ponti. In that city, however, her work was particularly limited to interior design, illustration and the editing of texts for magazines. She even directed the famed publication "Domus" with Pagani, toward the end of the conflict, and founded, along with Pagani and Bruno Zevi, the magazine "A: Cultura della Vita[10]." A proponent of modern architecture, she was up to speed on its discourses both internationally and at home, where the architectural culture was branded in intricate and multifaceted manners by the dilemmas of identity, translated at times in terms of *mediterraneità*, classicism and, later on, neorealism. The experience of fascism and the war had marked the Bardis in several ways: Pietro had initially been a supporter, believing in the possibilities of transforming artistic culture, but he was persecuted by the fascist police nevertheless and did not go through the clearance processes that took place after the conflict[11]. For Lina, the war was a harsh political formation and life experience that would reinforce her objections to the regime, which matured in the conflict. Arriving in Rio de Janeiro just over a year after fighting had ended, the couple found a recently democratized country with an effervescent output of modern architecture that was acclaimed abroad: a place filled with promise for life, work and the realization of the ideals of art[12].

After Chateaubriand's decision to establish the museum's headquarters in São Paulo, the couple moved to the city. For a period, they lived in the modern residence designed by Italian architect Daniele Calabi, who came to Brazil in 1939 fleeing Italy's race laws, only to return in 1948[13]. It was a house of particular character, built in the suburban neighborhood of Jardim do Pacabembú, with a patio and a portico that framed the landscape of that São Paulo in a phase of accelerated growth. The city would grant Lina the possibility to design her own house, her first architectural volume to be constructed, no longer ephemeral like her interior designs up to that point, but actually built to last, a symbol of the decision to remain in the country, recast their own history and construct their own trajectory in it.

Figure 2
Lina Bo Bardi on the balcony of her first residence in São Paulo, project by Daniele Calabi, 1945. Photo: PMB. Source: IB

The purchase of the lots in Jardim Morumby

On May 19, 1949, the Bardis signed a Commitment of Sale and Purchase of two plots of land, lots 05 and 06 on block 08 of the recently subdivided Jardim Morumby[14], located on the other side of the Pinheiros River, the region previously home to the Muller Carioba Tea Farm. This land was paid for by the Bardis over a number of years to the Morumby Real Estate Company [Companhia Imobiliária do Morumby], represented by Luiz Oliveira de Barros, in installments that included the implementation of electricity, running water, paved roads and forestation. The lots chosen were located at one of the highest spots in the region, nearby Avenida Morumbi and the old Farmhouse, as well as an old chapel, binding the future residence to an idea of the past, nature and a landscape that glimpsed the new profile of the city of São Paulo from afar.

Lina was the one listed on the contract as the owner of the land. In this document, the rules of land division as well as the alignments and templates of the buildings to be constructed are underlined, indicating that the architect had probably studied them. They stipulate that the lots be occupied exclusively by isolated residences of two stories or less, at a distance from the property lines with large indentations, closed off by walls that were not to exceed one meter in height and, in the event of the need for support walls, they had to be covered by vines or hedges which the owners committed to maintain well. They envisaged the materialization of the formation of a city inspired by the American suburbs, with low density and large gardens implanted in a sinuous roadway with cul-de-sacs, influenced, in turn, by the English idea of the City-Garden, and anchored in a manner that sought to strike a compromise with that singular geography of hills which still held large forested areas, plantations and pastures.

Though the new land divisions were part of the ongoing process of horizontal expansion of the city limits, simultaneous to the ever-increasing verticalization of the city center and its surroundings, they represented an exception given their designation for elites, planning and relative proximity to the center unlike many other poor areas characterized by the do-it-yourself construction that emerged at that moment.

The Morumby Real Estate Company's pamphlets employed a variety of resources to attract elite buyers: the old farmhouse served to provide the place with airs of old Portuguese nobility, while stories of the *bandeirantes* and the hunting fields and imagery of the indigenous chief Caiubí's retreat were mobilized as values. The Casa de Vidro also played a role in the propaganda: it was the first construction in the subdivision and promoted the image of a modern neighborhood, one of bold, modern architecture in coexistence with nature.

In the fifth issue of "Habitat," the art and architecture magazine promoted by the cultural activities of the Bardis in Brazil, Lina, editorial director at the time, presented a photo of the vegetation in Morumbi and proposed that the neighborhood be constructed in "rigorously contemporary" molds, encouraging the hiring of architects like Oswaldo Bratke and Gregory Warchavchik who then collaborated with the companies that subdivided the land in the region. Her intention was to provide a modern unity to these new spaces that would repel the image of neighborhoods like Jardim América or Jardim Europa, characterized, according to her, by "people with lots of money, and lots of bad taste too" (Morumbi, 1951, p. 66).

Part of the sub-prefecture of Santo Amaro at the time, *Jardim Morumby,* where the Casa de Vidro was situated, was adjacent and practically contemporary to the *Paineiras do Morumbi*, a subdivision designed by Bratke, who built his house there in 1951, also using it a laboratory for modern construction and life in the suburbs[15].

The Bardi Institute's archives contain a copy of the blueprints for *Jardim Morumby*, with a stamp attributing authorship to the civil engineering firm of Américo de Carvalho Ramos, who had modified the land development in 1946 and 1947. On it, we see two sets of lots marked in yellow pencil: one corresponds to the lots designated for the Casa de Vidro, the other for the "Land reserved for the 'Art Institute of São Paulo.'" We know of the latter destination because of the caption of one amplified drawing of the same lots, undated, included in the archive of Warchavchik's projects[16] at Fau-Usp. The same drawing would reappear in 1986, in the request to landmark the Casa de Vidro authored by the Bardis. On it, we read in Lina's handwriting: "blueprint of the lots where the studios of Masp's Contemporary Art Institute - Iac should have been been built in 1953." After, she wrote: "Blueprint of the Lots for Masp, acquired by the Diários Associados and later soldÐ (Bo Bardi, 1986, p. 34). Thus, she reinforced the idea that part of Masp's design school[17] should have been implanted there and explained that the Casa de Vidro should have been its Cultural Center. According to the architect, with the plan's failure, the house was left over to serve as the couple's residence. Though I recall that the Iac was only officially founded in 1951, it could well be true, according to this narrative recounted by Lina in 1986 and indicated by the clue found in the Warchavchik archive, that it was in the works since 1949, when the Bardis purchased their plots of land.

Warchavchik was linked to the development of the neighborhood and he was the author of the projects for the "Reform of the Farm House for the Morumby Country Club" in 1948 and the "Renovation of the Morumby Chapel," as he himself named it, in addition to two houses in the new subdivision, designed in 1950. An architect who played a fundamental role in introducing modern architecture in Brazil and connected to the cultural proposal of the modernist group in São Paulo, he shared with the Bardis the experience of foreign origins, having come from the Ukraine, and with Lina he shared the experience of having been educated at the same Roman architecture school, as well as having lived in Italy for a few years. According to Zeuler Lima (2013, p. 55), a scholar of Lina's career and architecture, it was Warchavchik who introduced Pietro to the neighborhood. A bit later on, the architect would once again play a part in the house's history.

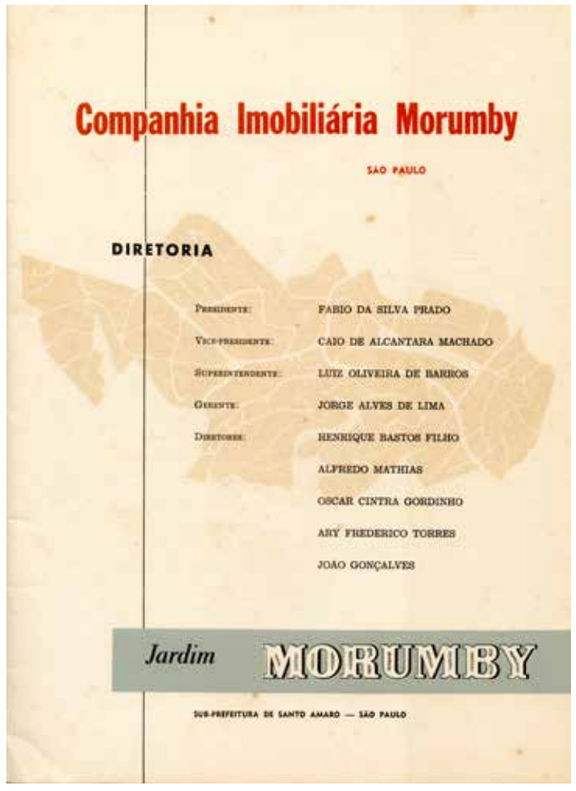


Figure 3
Cover an advertising flyer for Morumby Garden, s / d. Source: IB

Figure 4
Morumby Real Estate Company, page of report submitted to shareholders about Morumby Garden, 1953. Source: IB

Figure 5
Morumby Allotment plan with highlights of the Casa de Vidro (above) and IAC (center) lots in yellow. Ink, graphite, crayons, printing, on offset paper. Source: IB

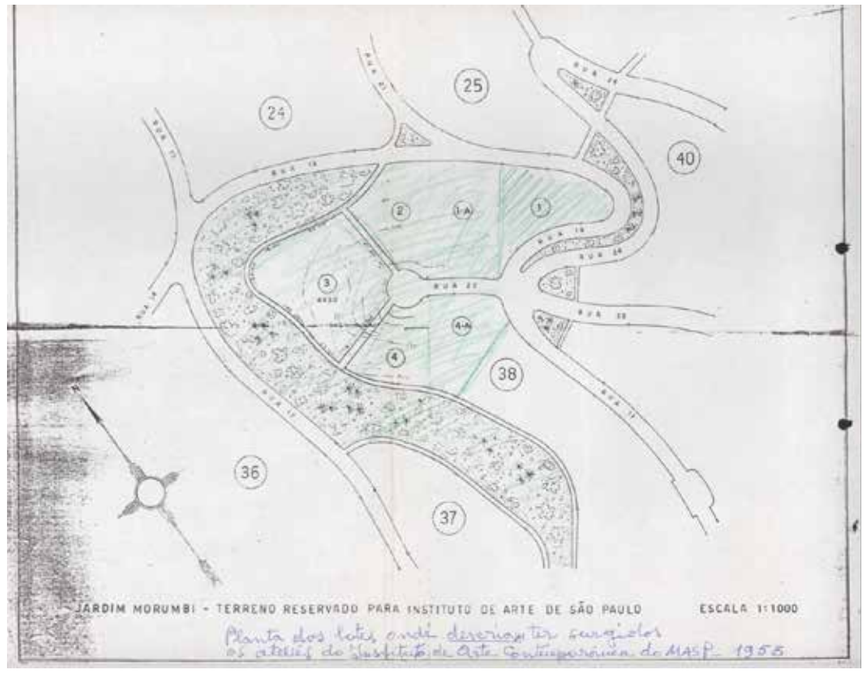


Figure 6
Land reserved for the Institute of Contemporary Art, by Masp. Page of the Casa de Vidro listing process by Condephaat, with notes by Lina Bo Bardi. Source: www.arquicultura.com.br

Figure 7
Side view of the Casa de Vidro with the caretaker's house in the foreground. Photo: PMB. Source: IB.

Figure 8
View from the corner of the Casa de Vidro' living room. Photo: PMB. Source: IB.

Lina Bo Bardi's project

Architects and architecture historians have dedicated themselves to understanding Lina's project for the Casa de Vidro, seeking to interpret the reasoning behind its forms, to understand her process in developing it, to discern the intricate network of choices that produced it. Ponti, the first one to christen it the Casa de Vidro, back in 1953, recognized the dual character of its final result with its great glazed, periscopic main room – the place of day, of empty space, light, air, sun and green -, and with its bedroom section – the place of night, walled and secret -, holding the kitchen in its depths. He believed that the house was a tribute to Brazil, which had motivated it, and Italy, from whose architectural school it had been derived.

More recent readings, based on methods and questions from the history of architecture, have come up with new interpretations. Maria de Fatima de Mello Barreto Campello's dissertation from 1997 attempts to pinpoint the project's generators: for her, they could be found as much in the dead tree on the patio, as in the choice of the site as an overlook where Lina would design a geometric project, representative of order and rationality in the face of nature. In 1999, Renato Anelli interpreted a peculiar mark of a certain architecture of Italian immigrants to Brazil in the house's patios and its relationship with Brazilian nature. In 2006, Olivia de Oliveira called the house's glass walls "landscape-walls," underlining the relationship between architecture and nature in this, and

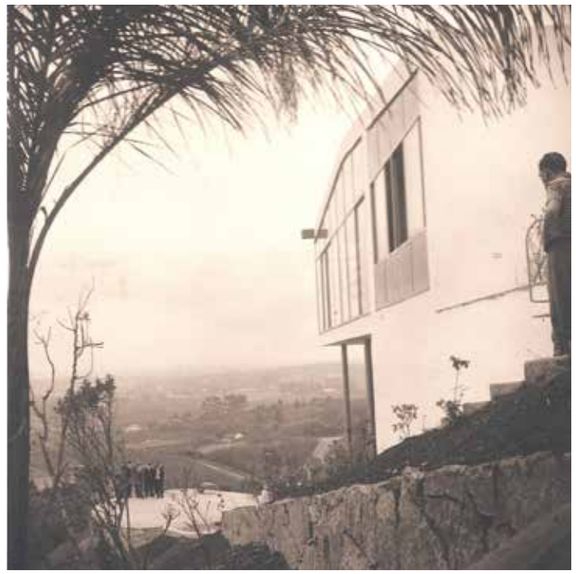


Figure 9
Glass house interior with few furniture and no curtain. View of Santo Amaro district on the horizon. Photo s / d PMB. IB source

Figure 10
Side view of the Casa de Vidro towards the landscape with unidentified visitors. Photo: PMB. Source: IB.

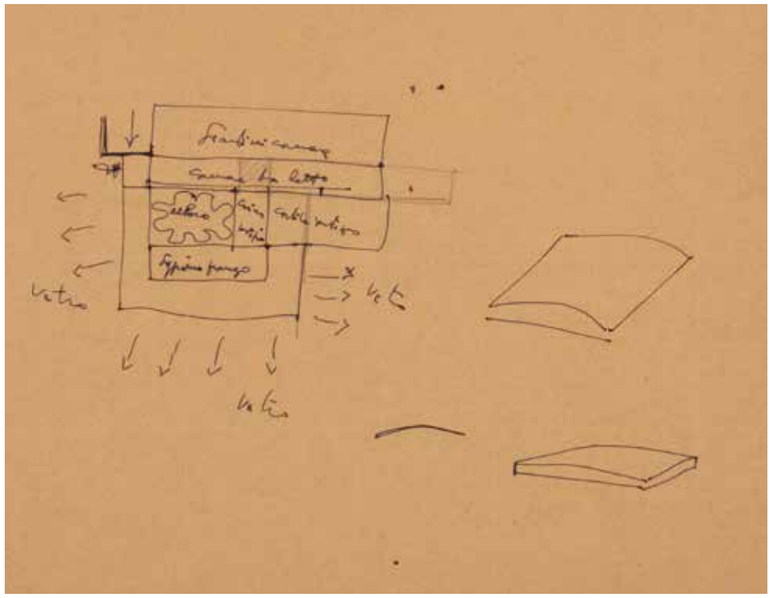
the rest of the architect's work. The author also recognized the project's affinity with the ideas of modern masters like Mies Van der Rohe and Le Corbusier. For her, the house was built of "air, light, nature and works of art" (the subtle substances that Lina used and affirmed as architectural materials) and characterized by its transformation over time, the ever-increasing presence of nature and the objects in the face of its own architecture. More recently, Lima (2013) emphasized this relationship between architecture and nature and observed the extent to which the project preserved the traditional divisions of gender and class in Brazilian houses, pointing out that the service area block is in the shadow of the main part of the house. Ultimately, he stressed Lina's desire to reconcile modernity and tradition, providing continuity to the Italian debate.

Like some of these authors[18], I believe that Lina initiated her project during the purchase of the land, namely in the first half of 1949. The sketches and drawings created by the architect and conserved at the Bardi Institute are rich and abundant, but they aren't dated, thus making it difficult to understand the exact sequence of the generation of forms and choices, even with the aid of various scholars who attempted to reconstruct it[19]. These sketches bring to light a system of ideas and, in them, we recognize some decisions in terms of materials. The word *vetro* [glass], for example, has an important presence, just like the drawing of the works of art and the nature and scenery that the glass should bring into the residence's interiors. For Lina, glass appeared as a possibility for implementing her idea of a Platform-House, an Observation Deck-House entirely connected to surroundings of vegetation and the landscape.

Figure 11
Photo of tree trunk and patio at Casa deVidro. Photo: Peter Scheier. Source: IB

Figure 12
Sketches drawn by Lina Bo Bardi for the Casa de Vidro project. 1950 c. Source: IB.

Figure 13
Longitudinal and cross sections of the built version of Casa de Vidro. Nanjing on paper. Source: IB.



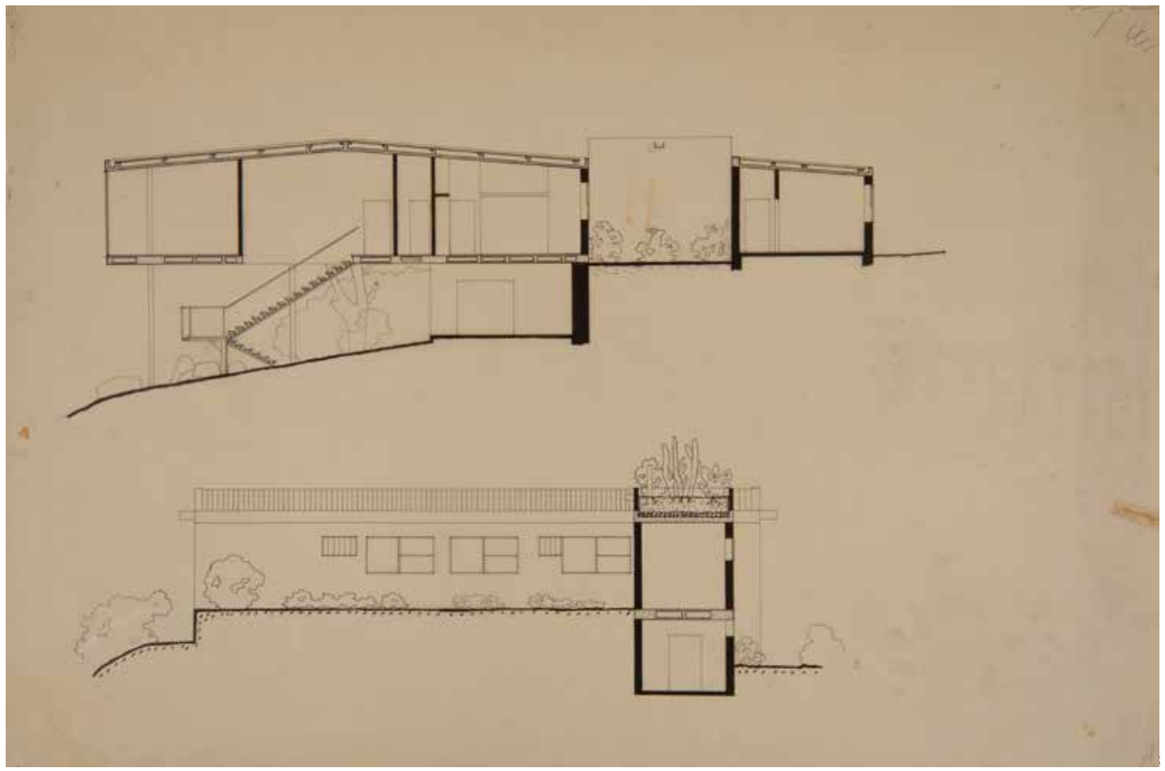
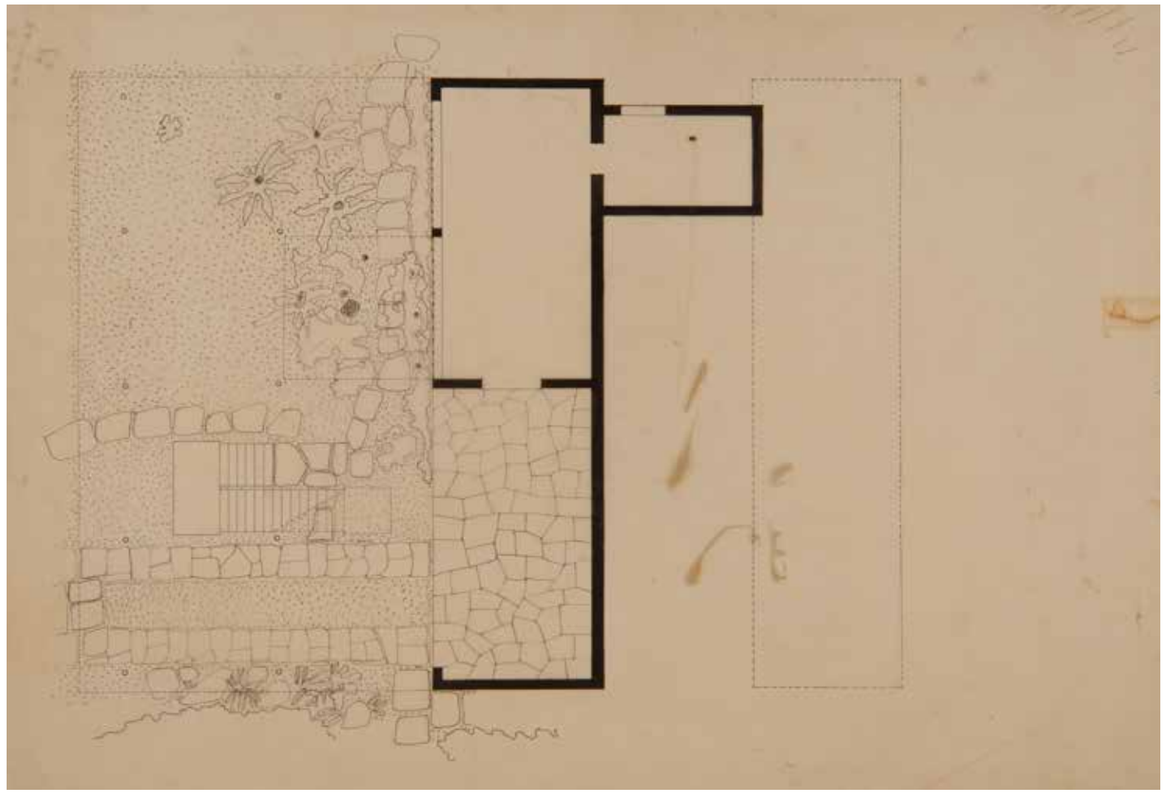


Figure 14
Plan of pilotis and technical area of the built version of Casa de Vidro. Nanjing on paper. Source: IB.

Figure 15
Main floor plan of the built version of Casa de Vidro. Nanjing on paper. s / d Source: IB



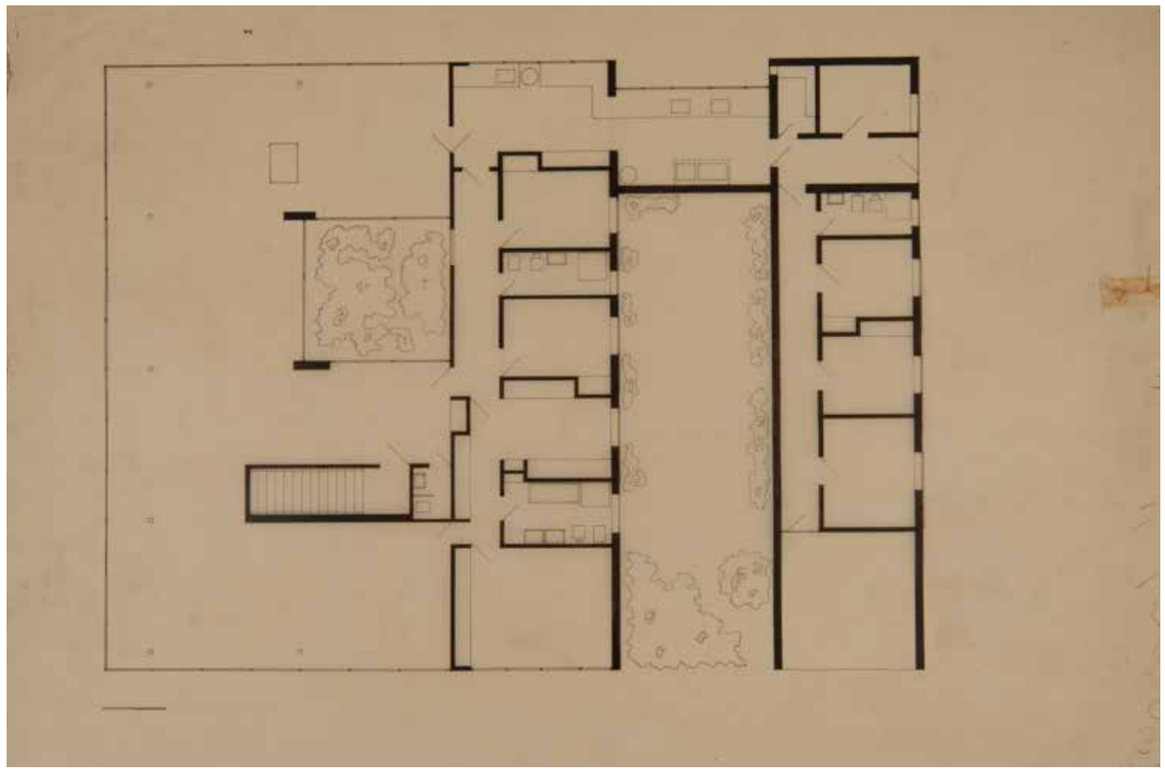


Figure 16
Cover of the magazine Il Vetro, n. 10, Oct. 1938. Direction, composition and pagination by Pietro Maria Bardi. Source: IB.

For Pietro there was also a particular meaning in the use of that material, of which he was an advocate. In 1934, for example, he titled an article of his published in "Quadrante" *The glass revolution*. Six years later, writing in the book *L'industria del vetro in Italia,* anonymously, due to his persecutions by fascists (as demonstrated by Tentori, 2000) -, he would declare:

> Glass is an element upon which significant characteristics are founded, characteristics representative of our time [...] Today, glass is one of the prominent elements of Modern Architecture: it has a dominant role [...] and the conquest of air and light achieved in our age – by way of the new architecture – is mainly [its] merit [...] but being that light is the first necessity of life, only the present can – and should – be the age of glass, a triumph of mystery in the most scientific age of the human race (L'industrial del vetro in Italia, 1940 apud TENTORI, 2000, p. 150 and 153).

From the late 1930s to the early 1940s, Pietro also had a fundamental role in the editorial office at the magazine "Il Vetro," using it to address one of his favorite subjects: modern Italian architecture and an ideal selection of its protagonists. It's worth noting that while still in Italy, Pietro had the opportunity to work as architect on projects that were heavy on experimentation with glass. As such, his investment in transparency appeared in a study for the art gallery[20], capable of exposing and mediating the relationship with forms and images, building one of the themes dearest to him, that is, the design of machines to allow people to see and experience art, much like his own house, to a certain extent.

It does not seem coincidental that in December of 1949 he wrote to the Industrial Society of Insulating Glass in Santo André asking for information on their products, as indicated by documents found in Masp's archives. There, I also found correspondence dated from 1949 and 1950 (precisely the time when the House was being planned), between Pietro and the *Centro Informazioni e Studi per le Applicazioni del Vetro nell'edilizia e nell'arredamento* ["The Center for information and studies on the application of glass in construction and decoration"] - Cisav. The museum's director sent photos and provided explanations on the use of glass in its interiors[21], as was the case in *Exposições didáticas*[22], exhibitions dedicated to exploring a number of artistic

Figure 17
Showcase of the forms and Pinacoteca in the extension of Masp, Lina Bo Bardi, 1950. Source: IB.

themes. The Studio Palma in Rome assisted in the content editing for the exhibits and Lina handled the exhibition design, which featured crystal panels supported on top of metallic tubes, bearing a resemblance to their house, designed like a crystal box supported by metal tubes. In the museum's expansion project, designed in 1949 and 1950, which the architect worked on basically simultaneously to the house's project, she also created another didactic device, the *Vitrine das formas*: a suspended, elongated glass box, like the Casa de Vidro[23], internally peopled by objects from various time periods, from pharmacy flasks from the 19th century, roots and even an Olivetti typewriter.

The House and the *Vitrine* were configured as devices capable of setting different objects together floating in space, united by wonderment like in the metaphysical paintings. This was a feature unique to Italian art during the interwar and postwar periods, developed by such architects as Franco Albini and Ignazio Gardella and inspired by the lessons of the art critic and author of design projects Edoardo Persico. The use of the tubes in Lina's exhibit design and in the Casa de Vidro had already appeared, for instance, in Edoardo Persico and Marcello Nizzoli's 1934 project for the Parker stationary shop at Largo Santa Margherita, in which the items for sale were suspended in glass boxes[24]. Also in 1934, Albini suspended off the ground, through the use of tubes, the exhibitive panels at the INA Pavilion in Bari and the project for the *Aerodynamics Hall inside the Aeronautical Exhibit*. This procedure was put into practice at the same exhibition, inside the *Hall of Raids and Records* by Giancarlo Palanti, then Albini's partner. Not coincidentally, Lina's sketches of the interiors of the Casa de Vidro featured unattached tubes in the space, in the form of thin lines, suspending paintings and sculptures. The same procedure was utilized by her in the first project for MASP's exhibit design in 1947, by Gardella ten years earlier in his project for the Piazza Aquileia apartment and by Albini in apartments on Via Alessandri in 1938.

At the moment when Lina began designing the house, she had initiated her partnership with the aforementioned architect Palanti, a representative of that same Italian culture of exhibit design and co-author of projects with

Figure 18
Panels suspended in space in the Gold Medal Room of the Italian Aeronautics Exhibition, designed by Edoardo Persico and Marcello Nizzoli, 1934, in Casabella magazine, n. 141, 1939 p. 41. Source: IB. Photo: Lucas Corato

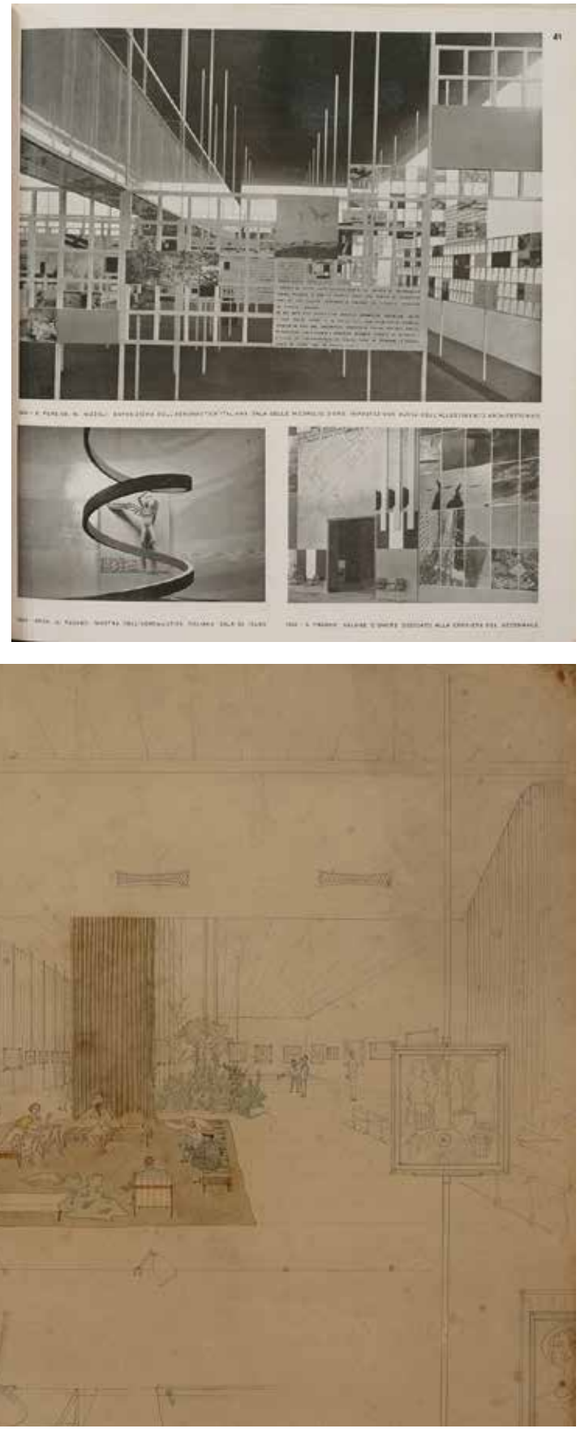


Figure 19
Internal perspective of exhibition at Masp - April 7th Street, Lina Bo Bardi, 1947. Technique: Sketch with watercolor, graphite on cardboard. Source: IB.

Figure 20
Sketch for the interior of the Casa de Vidro living room, drawing by Lina Bo Bardi, 1950 c. Sketch, crayons, ink on offset paper. Source: IB.

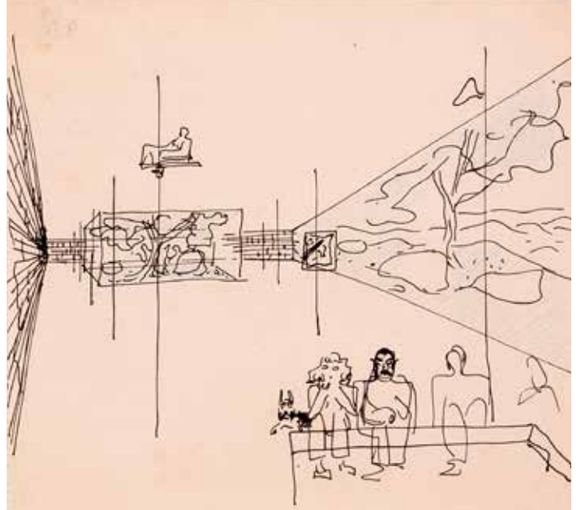
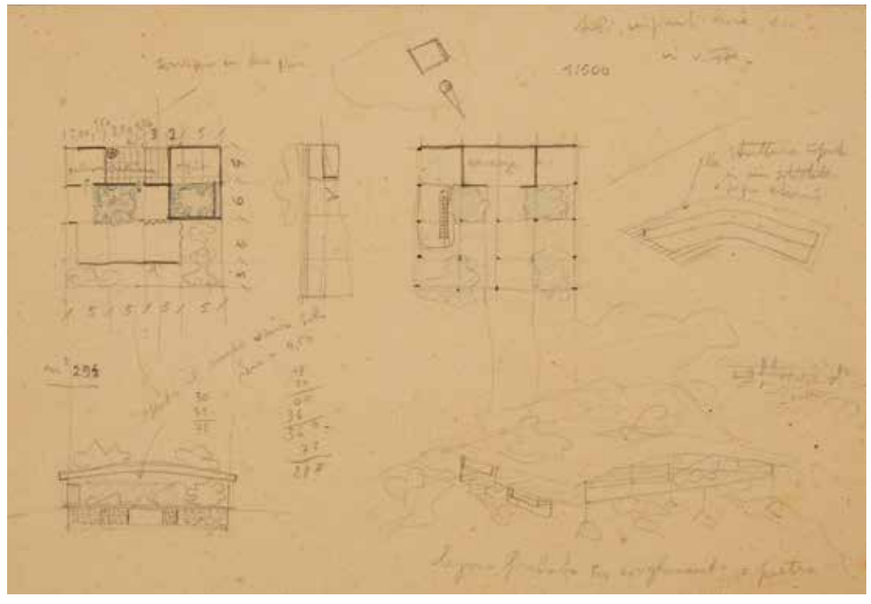
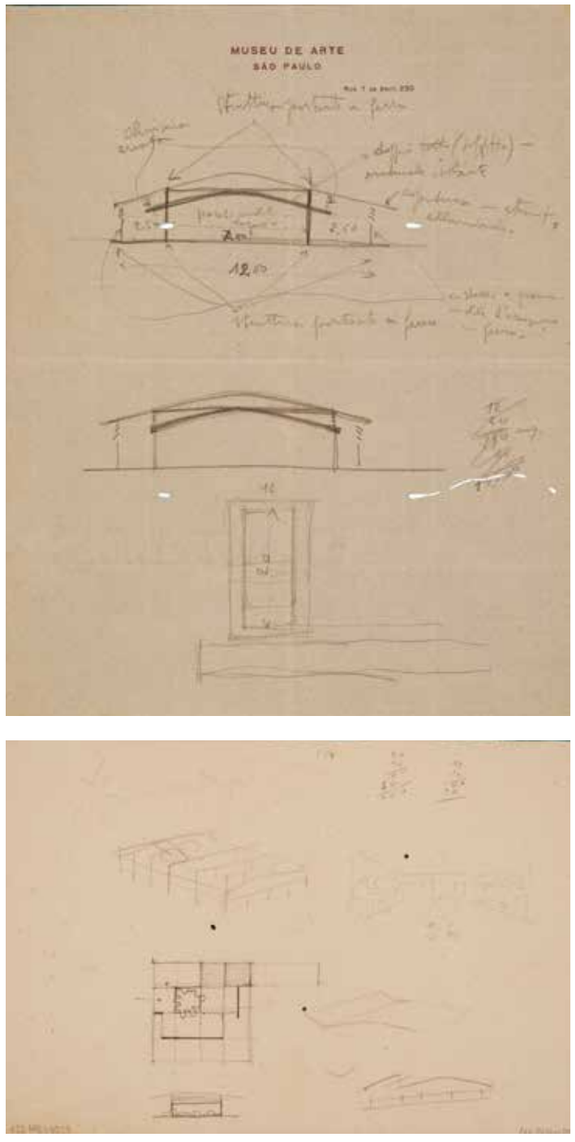


Figure 21
Sketch for the interior of the Casa de Vidro room with the couple in the foreground, drawing by Lina Bo Bardi, 1950 c. Sketch, crayons, ink on offset paper. Source: IB.

Figure 22
Sketches of plans and sections of the Casa de Vidro project, drawings by Lina Bo Bardi. 1950 c. Graphite on offset paper. Source: IB.



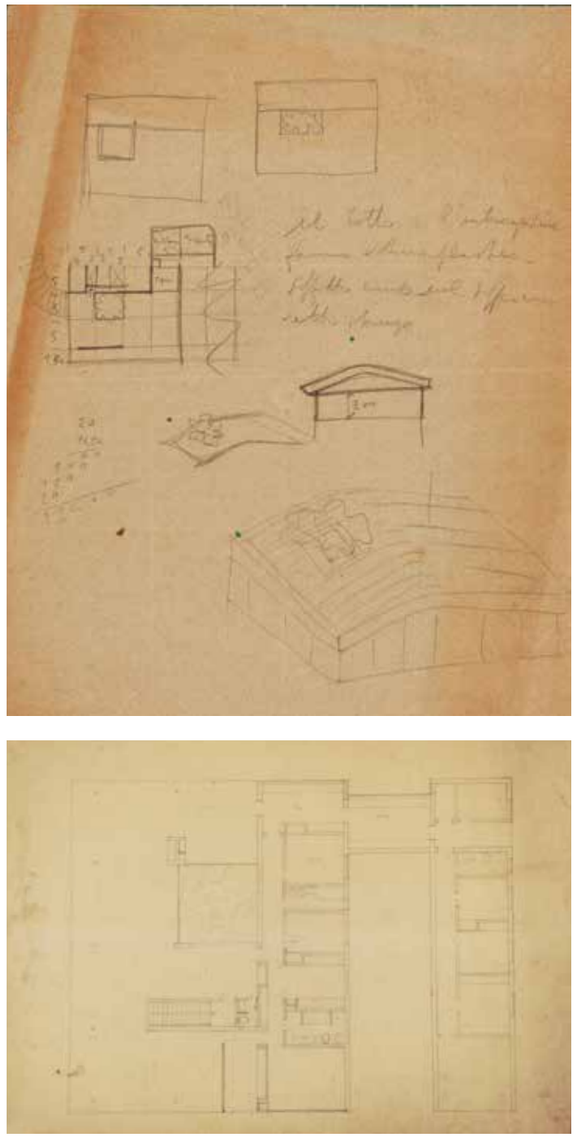


Persico, Albini and Gardella. Just eight years her senior, he had enjoyed a career decorated with awards, victories in competitions and vital projects. He had been a professor at the Polytechnic University of Milan at the time he emigrated to Brazil, like Lina and Pietro, in 1946. With Palanti, Lina attempted to further elevate the design and mass production of modern furniture in the so-called *Studio de Arte Palma*, founded in São Paulo in 1948. As with the Casa de Vidro, they employed both industrial materials like plywood and metallic tubes, as well as those with artisanal and folk-art origins, such as atanado leather and sisal fibers[25].

At Studio Palma, the duo also executed a number of residential projects, including one for Guilherme Kraus in 1949. It was a one-story house with three patios and an exposed-brick façade, and the choices they made demonstrated a world of materials very similar to that of the Casa de Vidro: iron columns and common brick and exposed brick masonry in the structure, slabs of reinforced concrete with pierced bricks throughout the entire building, waterproofed at some points and covered with a structure made of peroba timber and "Eternit" (a brand of asbestos cement) roofing tiles at others, as well as large, sliding glass doors, presented in a descriptive memorandum prepared by engineer Jorge da Conceição Gomes as transparent, double glass doors produced in Brazil.

Palanti also collaborated with Lina on Masp's expansion project, inaugurated in 1951[26], when again they employed tubes to suspend the panels supporting the works of art. To suspend the Casa de Vidro in space, the architect ultimately decided to utilize Mannesman tubes — seamless steel tubes produced by the German company, previously employed in Italy's aforementioned exhibit design culture. Such choice of metallic tubes suggests still Lina's admiration for the works by Mies van der Rohe[27] and Albert Frey, whose *Kocher Canvas Weekend House* from 1934 she published in Domus in 1944 (in an article about houses featuring pilotis) as an example of how by using steel structure one could achieve maximum visual lightness[28]. Also, the furniture designed for the house's interior were constituted of iron tube structures (as she had previously used in some armchairs at Studio Palma), including the library bookcases with glass shelves, just like the structure of her most famous chair, Bardi's Bowl, from 1951, designed when construction began on the Casa de Vidro.

Figures 23, 24
Casa de Vidro project development sketches, drawing by Lina Bo Bardi, 1950 c. Graphite on offset paper. Source: IB.



The house's curved roof was another element pursued by Lina in various sketches. The architect had previously tried out the same type of roof to demarcate the space of the MASP auditorium in 1947, and it would reappear in a number of studies from those years, such as those for the popular housing units designed in 1951. In one of the study sketches for the Casa de Vidro, drawn on museum letterhead, the architect tested out a double roof and made written notes in Italian on her material choices: "iron structure," "crystal," "Eternit or aluminum to cover," "isolating material." In another sketch she expressed her idea of architecture in a note: "brick house and industrial roof," that is, artisanal technique and technology for mass production. She also added that the roof was to comprise a volume with plasticity and should appear curved from inside the main room and flat in the bedrooms.

In addition to the sketches, the Bardi Institute collection also features preliminary technical drafts and drawings of the executive project. The drafts contain indications of finishings, even before final decisions were made, suggesting wood floors made of pau-marfim timber, black São Caetano ceramics in the bathrooms, painting and molding directly upon the bricks, as seen in the aforementioned Kraus house.

Lina's handwriting can be recognized on some of the executive drawings, especially those that refer to the interiors, namely the details of the kitchen, bathrooms, closets, furniture, bookshelves, fireplace, doors and rails. There are complementary presentation boards for the plumbing, storm-water pipes and electrical installations, as well as special details executed by the company "Estudos Técnicos 2R-E," designated for the casements, the guard rail frame of the large glass planes for the main room (not executed), the iron and granite access staircase, produced between May of 1951 and March of 1952, that is, when the House was already under construction, thus demonstrating the continuity of the project's process along with the development of the worksite.

Figures 25
Casa de Vidro project development sketches, drawing by Lina Bo Bardi, 1950 c. Graphite on offset paper. Source: IB.

Figure 26
Preliminary Design for the main floor, Casa de Vidro, 1950c. Graphite, on paper. Source: IB.

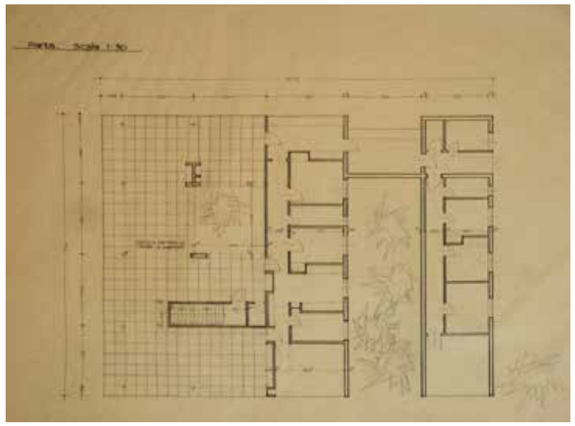


Figure 27
Pier Luigi Nervi study for the structure of the Glass House, "Villa Bo - Bardi a San Paolo", 1950 c, Source: Fondo Nervi, Pier Luigi, Biblioteca delle Arti and Spettacolo, Centro Studi and Archivio della Comunicazione CSAC Università di Parma - Fondo Pier Luigi Nervi

Pier Luigi Nervi's structural project

The structure with the Mannesman tubes and their modulation had already been introduced in Lina's previously-mentioned sketches and drawings. It was necessary to embark on the project and structural calculations, which Pietro and Lina initially solicited to Italian engineer Pier Luigi Nervi, the author of bold works with long span structures in reinforced concrete and also responsible for developing and patenting the *ferrocemento* system. Pietro was an admirer of his, having formerly realized a project with him in the competition for the Palace of Italian Civilization at the E42 Exhibition in Rome in 1937.

In a letter to Pietro dated November 25, 1950, now stored in the archives of MaXXI in Rome as well as at Masp, the engineer shared news of his arrival in Italy and thanked the Bardis for the hospitality they had showed him Brazil. He asked Pietro to tell Lina that he would begin his study for their house the next day and that he hoped to send them the executives in five or six days[29].

We know that Nervi had been in South America to administer two courses that year: one in Buenos Aires and another at Masp in São Paulo, where he taught 12 classes on various aspects of Reinforced Concrete, from calculation to execution, and managed to get 248 enrollments for the museum. The theme of his first class, "Construction technique considered architectural language," indicated the general pitch of the course and the manner in which he addressed structures.

The executive drawings were sent by Nervi in early December with the following explanations:

> In order to reduce the thickness of the flooring/ceiling and abolish the exposed beams, I adapted, after some attempts at other paths, a mixed solution with iron beams immersed in the conglomerate and slab. This is also the best way to obtain a good connection between the Mannesmann tube columns and the slabs, a connection which would be delicate and difficult with an exclusively concrete solution. I also believe that it could have advantages from a constructive point of view, given that you can assemble the skeleton of columns and beams, and complete the slabs after. If, however, the system faces difficulties in finding materials and local execution, do not hesitate to tell me so it can replaced by another solution[30].

The project sent by the engineer is missing from the Bardi Institute's archives, but the original drawings are found in the Nervi fund at the *Centri Studi e Archivio della Comunicazione* - Csac [31] in Parma, and are very insightful. Comprised of five boards, they involve 1) the plans for the slabs in 1:50; 2) foundations and slabs for the main room (a sample of the pilotis throughout the entire extension in 1:5); 3) slabs of the main room (a detail in 1:5 of the perimeter beams and part of the slab); 4) detail of the joining of the tubes and the beams of the slabs in 1:2; 5) slabs of the service area, 1:10. The collection also includes sketches that feature a small sample of the house and a study of the moments, envisaging a hyperstatic structure[32], as well as various drawings with annotated corrections.

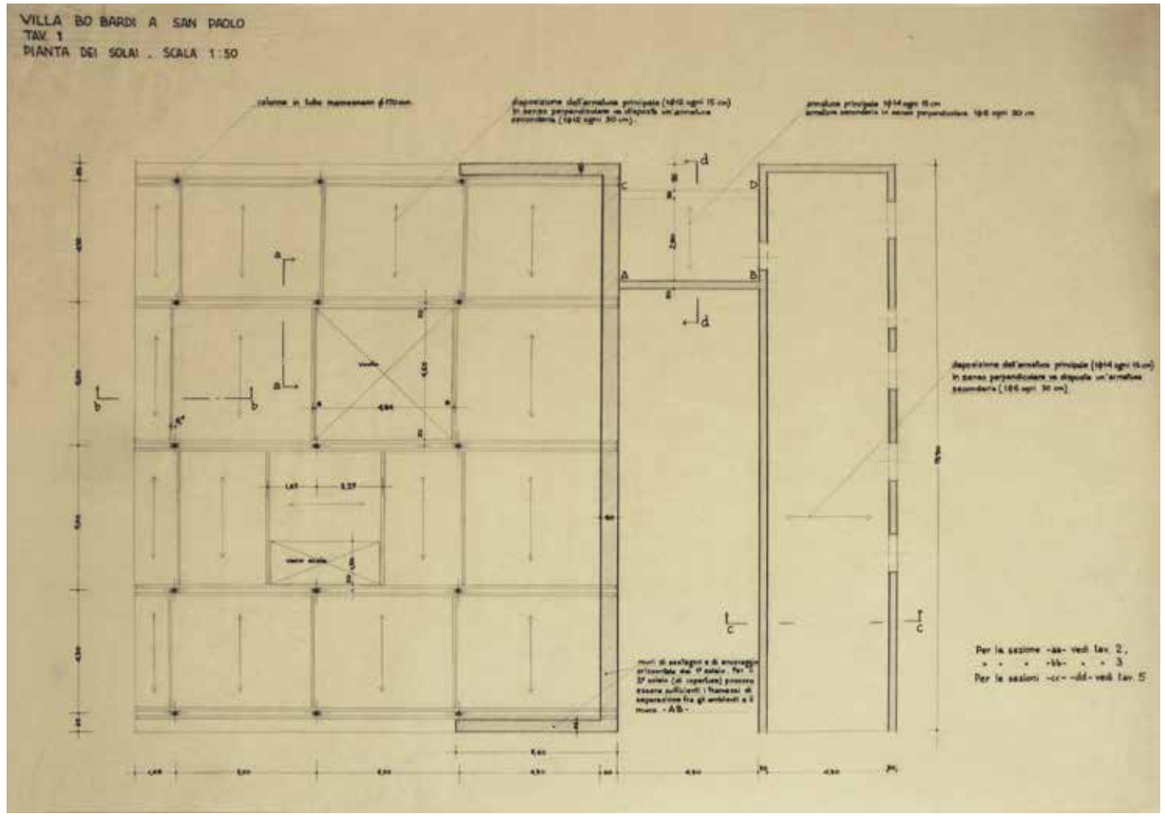


Figure 28
Pier Luigi Nervi's study of the arrangement of steel profile beams for the Glass House structure, "Villa Bo - Bardi a San Paolo", 1950 c, Source: Fondo Nervi, Pier Luigi, Biblioteca delle Arti and Spettacolo, Centro Studi and Archivio della Comunicazione CSAC Università di Parma - Fondo Pier Luigi Nervi

As the basis for his structural project, Nervi utilized a drawing of the residence's first floor layout, probably delivered to him by Lina when the engineer was in Brazil. The study of the distribution of the pilotis in the layout, according to the drawings that belong to the Csac, show that the final configuration of the house as we know it was already established. As such, though Lina's drawings of the Casa de Vidro are not dated, we can place them based on the intersection of these documents, when the project was relatively complete in November of 1950. The only alteration in terms of what was constructed appears in the absence of the separate fireplace (in the drawing it is attached to the structure in the corner of the internal patio), in the door separating the pantry from the kitchen (which would later disappear) and in the design of a cupboard. The module was one with which we were already familiar: 5x5 m between pilotis, with the exception of the extremities, indented from the windows, enabling the balance of the slabs.

For his project, Nervi indicated the use of Mannesman tubes with an external diameter no less than 17 centimeters, filled in with a high-quality conglomerate and mixed with care. A single tube should support the floor and the roof. The tubes and steel beams in profile C are to be soldered together, a process for which he recommended the utmost care, including regarding local executive modalities. The I Beams are thus to be bolted to the C Beams, composing, together with the pilotis, the structural skeleton. For the connection between the tubes and the foundations, a cage was planned positioned at the lower part of the tube, which opens up in the foundation footing like an umbrella, binding the two parts. The 13-centimeter thick concrete slab should be bound to the beams and tubes with steel and should also anticipate holes drilled into the metallic structure which is, in turn, immersed in the conglomerate of the slabs, with an inverted chapiter, like an upside down mushroom slab.

On January 15, 1951, Lina thanked Nervi for his project and praised his calculations, affirming that there would be no difficulties with the execution, since they were going to call on a company organized for the construction rather than an empirical "master." In effect, they would soon hire a construction company that was quite familiar with reinforced concrete.

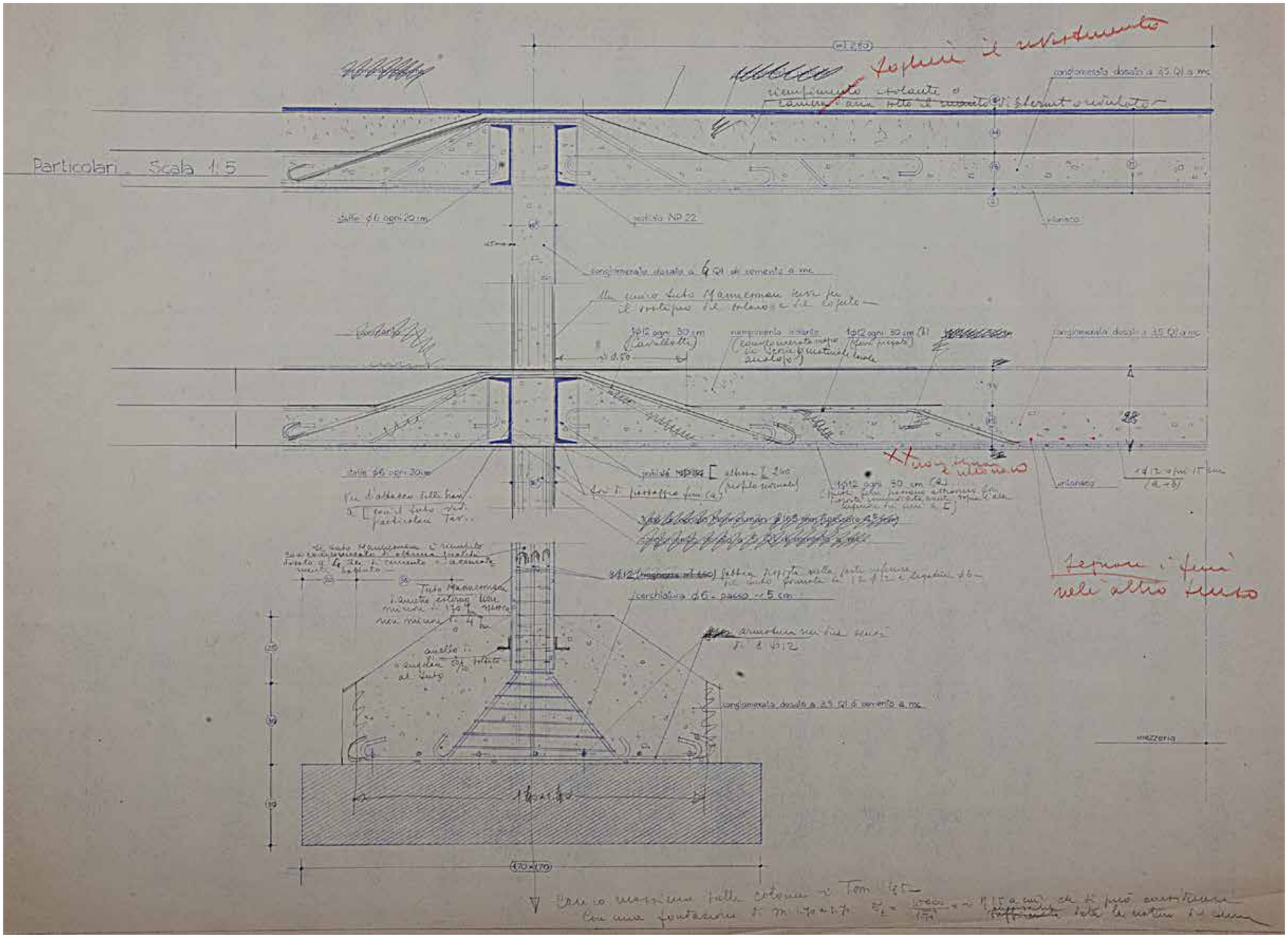


Figure 29
Pier Luigi Nervi study for the system of columns and metal beams with foundation and reinforced concrete slab. Glass House, "Villa Bo - Bardi a San Paolo", 1950 c, Source: Fondo Nervi, Pier Luigi, Biblioteca delle Arti and Spettacolo, Centro Studi and Archivio della Comunicazione CSAC Università di Parma - Fondo Pier Luigi Nervi

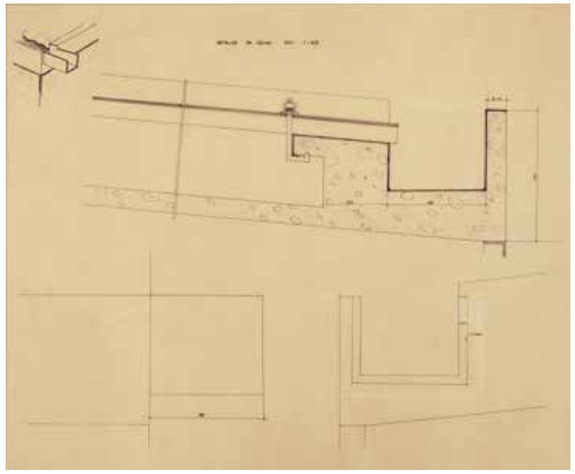


Figure 35
Detail of the Gutter, Roof and Platband of the Casa de Vidro, 1952c. Blueprint. Source: Bardi Institute.

Stucchi's solution, responding to the regulations of the pioneering Brazilian concrete norms of 1941 (Freitas, 2011 and Contier, 2014), addressed the difficulties that Nervi had pointed out in his letter concerning the delicate solution of connecting the metallic tubes filled with concrete and the slabs made exclusively of concrete, proposing a slab that was like a coffered slab for the ground floor of the first level that avoided, as Nervi had, having exposed beams, guaranteeing the formal cleanliness of the platform that Lina had imagined. Due to the loss of the presentation board from the archives, we don't know exactly how the connection between the pilotis and the slab was resolved. Curiously, in Lina's sketches, there is a drawing of a kind of inverted umbrella in the beam's interior formed out of iron coming out of the interior of the pilotis, constructing a chapiter in the beam's interior. In a statement, Suzuki explained that Lina talked about the structure of the house and said that he remembered an umbrella[42].

For the roofing slab, Stucchi proposed another system with reinforced concrete haunches supported by the pipes. The studies carried out by task groups 2 and 3 of this project showed that the pipes are not continuous, as Nervi intended. The fact that they are different tubes is proven in the service proposal sent to "prof. Pietro Maria Bardi", dated 1951, mentioned above, in which the use of Mannesmann pipes with reinforced concrete filling and the use of "Brasilit" (brand of fiber cement) pipes, also with reinforced concrete filling, on the first floor. When Lina demanded the declaration of heritage for the House in 1986, she would mention in the documents sent to Condephaat the use of these different tubes: Mannesman and Eternit, information confirmed by the recollections of her collaborators.

In both his and Nervi's projects, the design of the perimeter beam and the gutter imbedded in the slab are distinct. Ultimately, Stucchi also realized the structural project for the Caretaker's House, planned from that point on.

Nervi and Stucchi's projects reveal that part of the best concrete engineering talents from that era in Italy and in Brazil had been mobilized, going to great lengths to make viable the particular modern aesthetic planned by Lina, turning the worksite for the house into a place for experimentation and certain boldness.

It's worth observing that Sociedade Comercial Construtora was also responsible for the complementary projects for the installations of cold and hot water, sewers, storm water drains, electricity and respective memorandums envisaging pumps, an oil tank, boilers, radiator, clay shackles, cast iron columns and galvanized pipes, among others, recognizing that the concrete structure should be accompanied by these systems due to its complexity.

News from the worksite [43]

Construction on the Casa de Vidro must have been initiated after the Permit of July, 1951 and the finalization of the structural project. In the Bardi Institute's archives, there is a receipt of referral of the contract dating from early August.

After a few months, the construction work faced its first great challenge: the cement crisis plaguing Brazil and which made the execution of the structure difficult (up until halfway through the 1950s, Brazil's domestic market, despite national production, still depended on imports of the product, according to Santos (2011)). The result of this crisis was that the cement used in the House, according to bills of purchase over several months, came from different origins – Portland cement from Germany, Portland cement Cormim from England and Portland cement Votorantim and Perus from Brazil-, at times, bought on the "cement black market," as stated in one of Lina's letters[44]. Both in Stucchi's project as well as the notes, there are no further specifications concerning the concrete, being something inherent to the construction culture at the time. The price of the special structure, at the time of its finalization, was nearly double of what had been planned in the budget[45]. Still, the services provided by Sociedade Comercial Construtora must have been convenient for the Bardis, who also hired them to handle the execution and administration of the masonry and finishings on the work in late 1951.

In the Bardi Institute archive, there is an undated list for the "Casa Morumby," as the couple used to call it, with a sum of prices that synthesizes the phases, materials and work necessary for the house's construction, highlighting the difficulties in choices and possibilities for the windows in the following terms: "concrete structure with indication 'according to the budget from Comercial Construtora,' Brasilit roof; manpower for the roof; dividing brick walls with common brickwork; waterproofing service on the walls on the ground floor; finishing on the brick walls; internal finishings with two layers, heavy and fine; coating on the panels over the slab; oil painting and plaster, tempera in the service area; glass mosaic living room floor; glass mosaic kitchen and bathroom floors; bedroom floors of Brazilian ivory wood parquet; peroba timber parquet service area bedroom floors; ceramic service area hallway floors; large and small doors with installation and painting; casements and casement painting; mosquito net staircase; staircase (steps and granite); service for plumbing, heating; septic tank; water tank; electricity installation; windows 'tripled difference of Cr$25,5000.00'; various expenses for finishings (baseboards, chimney, range hood for kitchen); bathrooms appliances and various pieces; cement tank, kitchen sinks, stove," Then, subsequently in handwriting: "without oil painting and without crystal savings of 100,000[46]." More efficient in terms of thermal comfort, the triple glass was ultimately defeated in execution by the economy of the simple glass used.

The salary slips for the work, dated from 1952, feature the names of important figures in the building process: the construction workers who were employed from January to May, a total of over 35 men, divided into about 15 or 20 men on the worksite, per month, in the period of the structure's assembly and finishings. They were: Herminio Apolinario, Adão Schalathaner, Amadeu Pegoraro, Ananias Assumpção Netto, Antonio Adelino da Silva, Antonio Barranco Cruz, Antonio José Ayres, Aristides Oliveira, Augusto Barrocal Martins, Celio de Souza, Cesario F. Oliveira; Cesario O. Preto, Dorgival Monteiro; Durvalino de Souza; Durvalino Soares, Floriano Bedotti, Francisco Sanches, Giovani de Oliveira, Gualberto Raimundo, Honorato Camargo, Isaias S. Paiva, João C. Souza, João de Lima Bonfim, João G. de Souza, João Zanfolini, José Barros dos Santos, José F. Trindade, José Ribeiro Nascimento, Levino Soares Cruz, Lourival S. da Silva, Luiz Bonfim, Onofre Raimundo, Onofri Pettinatti, Osvaldo Gonçalves, Salvador Rossani, Sebastião José Ribeiro, Ubirajara Vieira and Vespasiano Bocchi.

The large quantity of bricks purchased between late March of 1952, as listed in the documents in the Institute's archives, seems to indicate the initiation of construction on the masonry. In the project's documents, the reference to Lina's name is always larger than Pietro's.

A letter from Construtora informed of the finalization of work on the structure on May 14, 1952[47]. That same month, Lina also solicited the sub-prefecture of Santo Amaro for the construction of the Caretaker's House, with a project of her design, but signed by the engineer Portugal, owner of the construction company. It was approved in June and the building permit was issued in July. This project for a compact bedroom and sitting room proposed a semi-buried volume in order to camouflage it in the ground and, as such, stipulated a support wall with a small air cushion which, however, was unable to solve the serious humidity problems that continued to plague that house.

In September of 1952, an inspection of the construction was solicited to the sub-prefecture. The inspection and official ready-for-habitation decree was signed on October 28th. The results were ultimately communicated by the construction company to Lina on November 19th.

At the beginning of this month, an invoice from the company Vitrais Conrado Sorgenicht S.A. indicates the removal and replacement of six pieces of glass, without informing which area of the house they were destined for. Based on the values, they could have been used on the windows in the bedrooms, bathrooms and service areas, or perhaps for the finishings on the kitchen cupboards or even the library shelves, also designed to be glass, in pursuit of an ideal of transparency and dematerialization, substituted after they broke, by formica cupboards and simple commercial iron stands painted blue.

On this point, it is important to remember that Vitrais Conrado Sorgenicht was a pioneering company in their area in Brazil. Founded in 1874 with the arrival of German artisan Conrado Sorgenicht, it became "Casa Conrado" in 1889[48]. Pietro was a friend of the family and called upon the company, as related by Regina Lara Silveira de Mello, to build the stained glass windows for the Armando Alvares Penteado Foundation building[49].

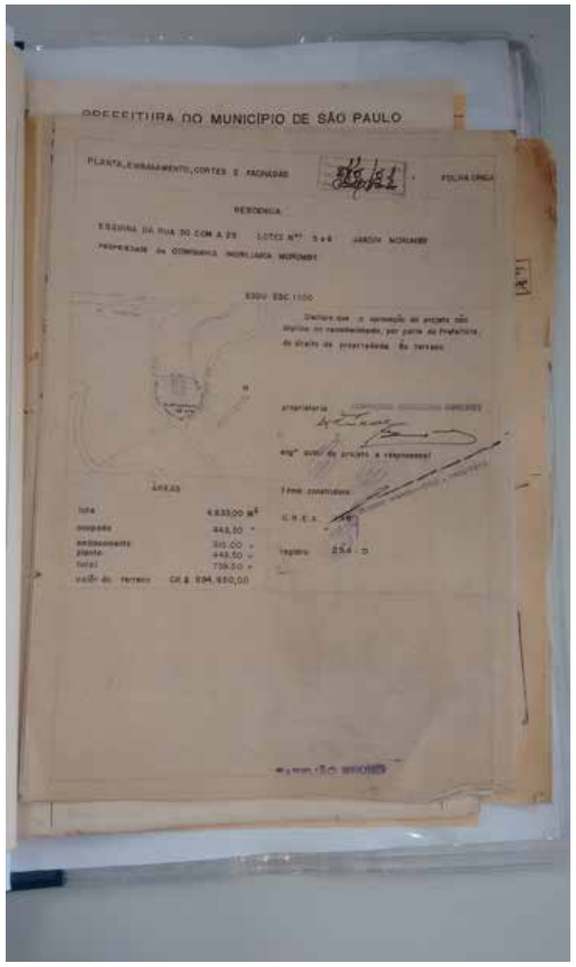


Figure 30
Gregori Warchavchik's signature and stamp as project author and responsible for the Casa de Vidro Project prepared for approval by the Santo Amaro Sub-Prefecture, 1951. Source: General Archive of Processes of the São Paulo City Hall.

The City's authorization of the project and Gregori Warchavchik's signature

The day after this letter was mailed, the authorization for the project of the Casa de Vidro was solicited to the Sub-Prefecture of Santo Amaro by the Morumbi Real Estate Company, signed by the architect Warchavchik, as attested by documents currently stored in the General Archive of Processes at São Paulo Municipal City Hall. Being a foreigner, Lina could not officially sign her work in Brazil according to the legislation in place at the time, unless she were to take a complicated exam or manage to get a degree from an architecture college in Brazil. Another alternative was for her to become a naturalized citizen, a process she would complete only in 1953. Warchavchik was already naturalized and legally registered with the council that regulated the profession.

The presentation board submitted for approval featured a project with a structural solution unlike the one suggested by Nervi: the pilotis had a rectangular section and were made of reinforced concrete, contradicting the notions of suspension proposed by Lina. The reason for this change was perhaps due to the fact that the designs had been prepared before the arrival of Nervi's solution for the unusual mixed structures with Mannesman tube pilotis (quite uncommon in Brazilian architectural production) or possibly for fear that the solution wouldn't be approved. Furthermore, there were other small variations: the fireplace did not appear, the layout of the glass wall casements was different, there was no curve in the roof. Where the library now stands was a closet and an L-shaped access staircase.

The descriptive memorandum of this approved project is also insightful in that it details the proposed finishing materials: tiles, parquet and ceramics for the floors, tiles for the walls of the pantry and bathroom, mortar made of limestone sand at a 1:3 ratio, in two layers on the interior and exterior of the remaining spaces.

After some corrections regarding the property lines, the Building Permit for the Casa de Vidro was issued in June 5, 1951.

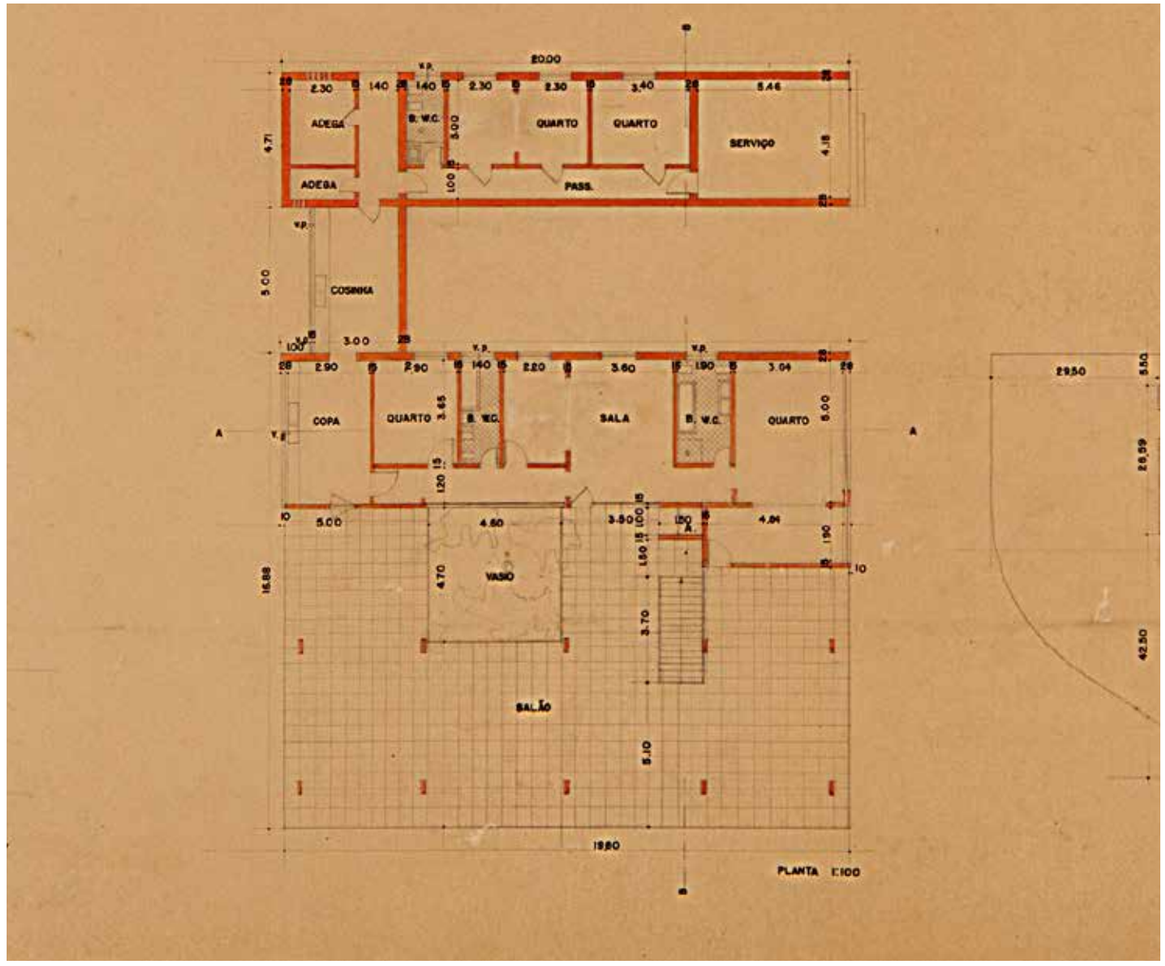


Figure 31
Detail of the Glass House Project prepared for City Hall approval, showing the rectangular reinforced concrete pillars in the living room. 1951. Source: IB.

The hiring of Sociedade Comercial Construtora S. A. and Tullio Stucchi's structural plan.

As promised in the letter to Nervi, Lina and Pietro hired an organized company to handle the construction of the house: *Sociedade Comercial Construtora S.A.*, one of the most important in the city at the time, responsible for large works of reinforced concrete, an area where Brazilian engineering had made major advances.

At the time, the company was owned by engineer Heitor Portugal and his partners included Luiz Fernando do Amaral, Ruy Prado de Mendonça and Jorge Alves de Lima[33]. According to Sylvia Ficher (2005) in her study on the engineer-architects from the Polytechnic School, this construction company maintained a complete technical staff, with an architecture department initially headed by Elisário Bahiana and Ferrucio Julio Pinotti that also executed projects for other professionals. A scholar of the history of the technique and technology in Brazil, Milton Vargas emphasized Sociedade Comercial e Construtora's role among those "responsible for the outbreak in the design and construction of large, reinforced concrete structures" in the country, and the emergence of "calculation offices," run by engineers who had considerable knowledge of applied mathematics in the stability of the structures, but some difficulty in controlling the behavior of the constructed works. (Vargas, 1994, p. 228).

When they were hired, *Construtora* was to execute the house's structure and support walls under a construction management contract, as written in the proposal letter sent to "Prof. Pietro Maria Bardi" in March of 1951. In this document, the company stated that it used its own calculations in the structural design, given the difficulty in acquiring the special laminated beams "specified by Professor Nervi's plan."[34] The proposal was then approved on May 28, 1951 and the contract was signed.

The author of the new calculations and the new structural design was engineer Tullio Stucchi, whose initials appear on the definitive executive drawings sent to Lina between June 7 and 26, 1951, with the following presentation boards: 1) Location of Pilotis, 2) Footing Blocks and Grade Beams; 3) Scaffolding of Wall, Grade Beams and Spread Footing; 4) Scaffolding of Foundations and Pilotis up to the Ceiling, 5) Forms and scaffolding of 1st slab; 6) Scaffolding of nervature; 7) Forms and scaffolding of the roof slab; 8) Gatehouse, slab scaffolding, gutter, beams and location of the Foundation. Added to them later were drawings of the beams and gutters in concrete, the scaffolding of the purlins, wall bracing. Unfortunately, the presentation board that refers to the scaffolding of the pilotis has vanished from the Bardi Institute's archives, making it difficult to gain a complete understanding of this structure.

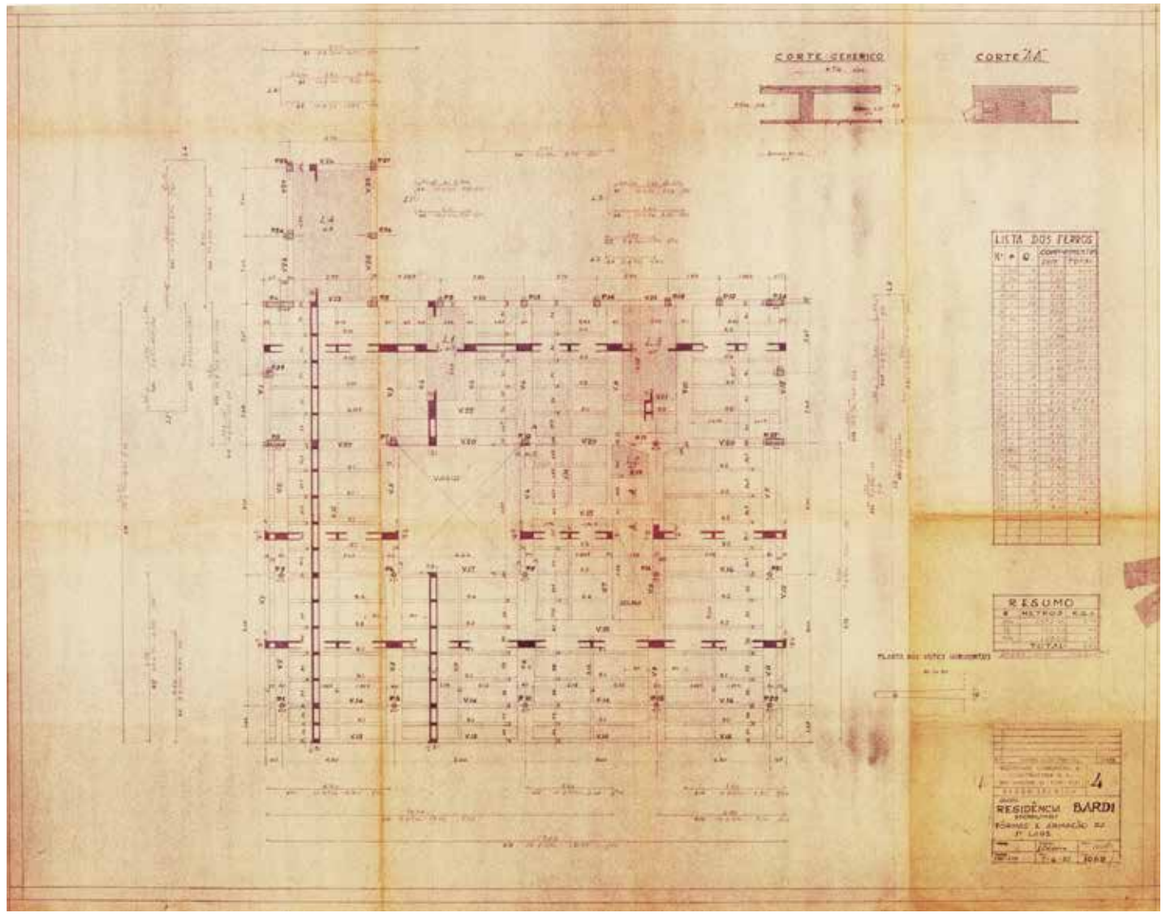


Figure 32
First Slab Shapes and Frame, Structural Design for the Glass House, Sheet 04, Engineer Tullio Stucchi, June 1951. Blueprint. Source: IB.

Figure 33
Northeast view of the Glass House Draft, Lina Bo Bardi. Graphite on paper. Source: IB.

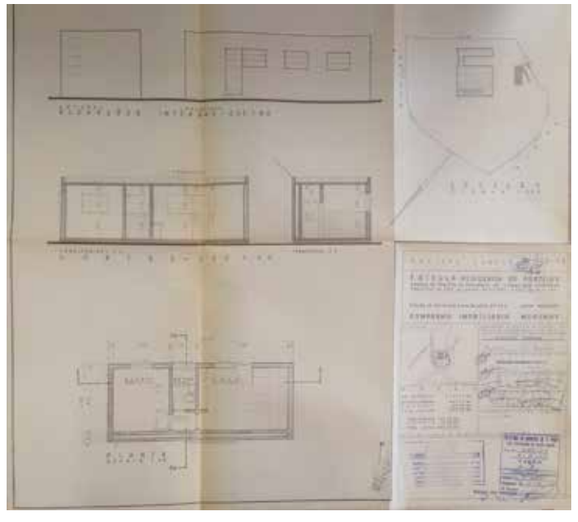


Figure 34
Project of the Casa de Vidro Caretaker's House prepared for City Hall approval, signed by Heitor de Portugal as project author and responsible, 1952. Source: General Archive of Processes of the São Paulo City Hall.

Born in Monte Azul Paulista, rural São Paulo in 1914, the engineer Stucchi[35] graduated from the Polytechnic School of the University of São Paulo in 1937. From 1944 on, he worked as a calculations engineer of reinforced concrete at Sociedade Comercial Construtora[36]. Before that, he was an engineer at the Division of Public Roadways and Works for São Paulo City Hall. Up until the realization of the project for the Casa de Vidro, he had accumulated experience on some important works such as the installations for the São Paulo Aeronautical Park, the industrial buildings for Santa Maria Glassworks, the San Martinho buildings at Praça Roosevelt and the structural project for the CBI Esplanada in 1946, a work executed by Companhia Comercial Construtora based on Lucjan Korngold's and Stucchi's structural project[37]. The building was recognized, at the time, as the largest reinforced concrete structure in the world[38], as the engineer himself explained on his resume, adding that he'd received countless letters from various countries, especially Australia, soliciting information on the structural calculations. This past experience left no doubt as to his competence in solving the difficulties of the project for the Casa de Vidro [39], something that would also prove useful in subsequent situations: Edifício Califórnia, designed by architect Oscar Niemeyer, the Unibanco Building at Praça do Patriarca - Ed. Barão de Iguape, with architecture by the American firm Som - Skidmore, Owings and Merrill)with Jacques Pilon and Giancarlo Gasperini; the Itaú Building on Avenida Paulista, with architecture by Rino Levi and the Ginásio Paulistano, with architecture by Paulo Mendes da Rocha[40]. From Stucchi's trajectory and the history of Construtora it's possible to ascertain that it was a kind of hothouse for various professionals experimenting with technologies that allowed for the solution and production of vital works of modern architecture in the city.

The communication between Lina and Construtora regarding the structural project demonstrates how she sought to best adjust it to her idea of architecture. In the letters sent to the engineers João de Albuquerque and Stucchi, she mentioned decisions about the accommodations of the quotas of Mannesman tubes in relation to the garden and the boundary, and, especially, asked for corrections regarding the central curvature of the roof of the slab that hadn't been accounted for in the structural project and which, as demonstrated by her diligence in the sketches, was fundamentally important to the architect. For Lina, the curve could not been created afterwards, in the plaster coating, something which would:

> (...) seriously impair the exterior look of the structure, in addition to rendering impossible the placements of the framework that would come at the center, to support against a coating 6 or 7 centimeters thick, something impossible and anti-constructive. Dr. João Albuquerque [finds himself] in agreement and is possession of the drawings, including those with the central curvature of the slab of the roof, a very small curvature but one which needs to be considered[41].

Figure 36
Advertising from Morumby Real Estate Company that includes photography of the Casa de Vidro under construction. Source: IB.

It wasn't possible to identify the origin of the flat glass in the Casa de Vidro's facades. According to Raquel Schenkman Contier (2014), an expert on the use of glass in Brazil, only after the war did Brazil produce flat glass for civil construction. Suzuki mentions that Lina had commented that the glass used in the house was imported from Belgium, a fact also confirmed by architect Marcelo Ferraz, a former collaborator of Lina's[50]. The only photograph of the worksite I was able to find, a photo used in an advertisement for the Morumby Real Estate Company, shows the house with the recently-installed windows.

Once it was newly completed, the house was thoroughly photographed by professionals Peter Scheier and Chico Albuquerque. Their images were then published in the magazines "Domus," "Habitat," "Casa e Jardim," "The architect and building news" and "Interiors" in issues published from February to May. Soon after, the house would be featured in other international magazines thanks to Pietro's efforts in sending texts and photos to editors. The text distributed by the Bardis placed an emphasis on the technical efforts mobilized for the house and its relationship with nature. It also explicitly mentioned the Mannesman tube structure that supported the extremely light platform made of reinforced concrete, emphasizing the glass consistency of the three facades, highlighting the "very thin" concrete roof with Eternit isolated with glass wool, the double iron plate with also the same isolation for the finishing, the aluminum plating on the roof of the kitchen where tropical plants grew, the protection from the sun provided by *Plavinil* plastic curtains which did away with the need for blinds and brise-soleils. In the captions of the photos sent, the two ovens built at the back of the house were described as "the moment that popular architecture enters an accord with contemporary architecture." In one of the images we can see the first garage built in the garden with tubes and a thatched roof, underlining the same accord mentioned above. Suzuki explained that Lina had said that this garage had been blown away in a storm one day.

Figure 37
Picture of the room without curtains and with furniture in the process of organization. Unidentified photographer, s / d. Source: IB.

Figure 38
Oven and Barbecue in the Garden of the Casa de Vidro. Photo by Chico Albuquerque, 1953. Source: IB.

Figure 39
Photo of the inner courtyard of the rooms, known as the Patio das Rosas, allows you to see the garden over the kitchen slab, the plant species and the chimney. Casa de Vidro, 1953. Photo: Chico Albuquerque. Source: IB.

Figure 40.
Side view of the Casa de Vidro accentuating the light and shadow contrasts in the laundry area and access to the Patio das Rosas. 1953. Photo: Chico Albuquerque. Source: IB.

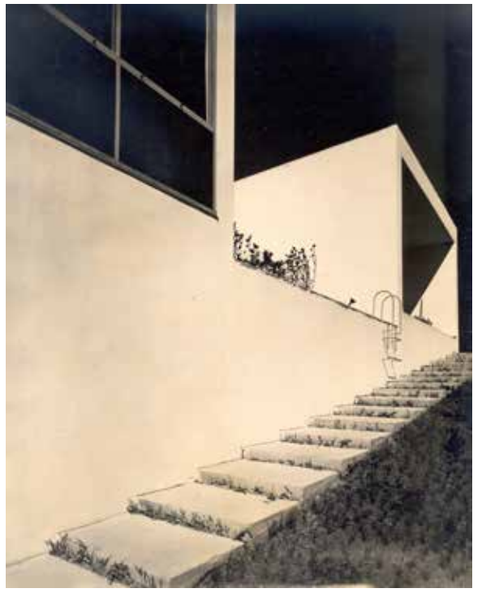


Figure 41
Kitchen with glass doors in cabinets. 1953. Unidentified photographer. Source: IB.

Figure 42
Library with glass shelves in the room of the Glass House. Unidentified photographer. Source: IB.

Figure 43
View from the room to the still green landscape of Morumby. In the foreground you can see the unprotected opening of the window from floor to ceiling. Below, the old garage. Photo: Peter Scheier 1953. Source: IB.

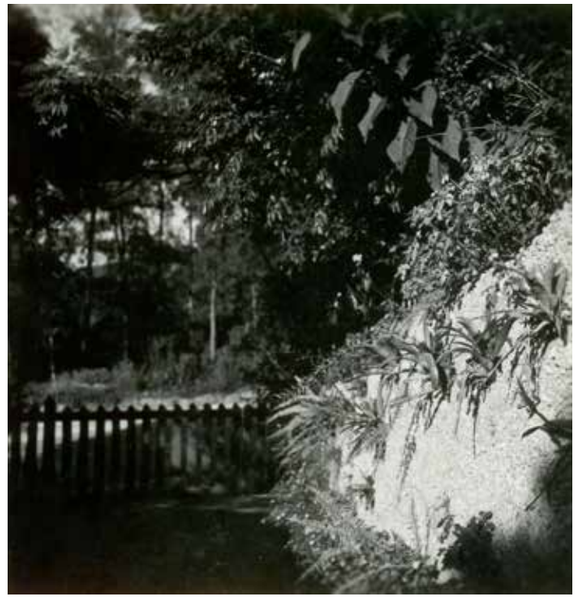


Figure 44
Access to the house with retaining wall and old gate. Photo: PMB. Source: IB.

Figure 45
Panoramic view from the Pilotis, seeing the city in the distance, the closest plan allotment, the “vasca”, access ramp and stairs in the foreground. Photo: Peter Sheier. Source: IB.


C V B - VITRAIS FRANCO
COMPANHIA COMERCIAL DE VIDROS DO BRASIL - CVB
RUA BELA CINTRA, 849 — TELEFONE, 34-0033 — SÃO PAULO
Mês de Jan 195
Dia | Nota N.º | Importância Cr$
21 24780 | 10.420,00
1/L. 35 a. 255
FATURA Nº Série A 43769
65 | 100 | 355,60 | 29-2-56 | 10.420,00
São Paulo, 31 de janeiro de 1956
Ilmo.(s) Sr.(s) DNA. LINA BARDI
estabelecido(s) Rua 7 de Abril, 230-13 s/ 1310
Cidade São Paulo
Estado São Paulo
Concedemos o desconto de ..X.. % s/ Cr$ ..X..
Por aumento de ..X..
Debitará a CVB - VITRAIS FRANCO - Cia. Comercial de Vidros do Brasil - CVB, estabelecida à Rua Bela Cintra, 389, São Paulo, a importância abaixo, referente à sua compra de mercadorias constantes das notas mencionadas nesta fatura.
ESTA FATURA NÃO VALE COMO RECIBO
Importa a presente fatura em:
DEZ MIL, QUATROCENTOS E VINTE CRUZEIROS.....
A DUPLICATA REFERENTE A ESTA FATURA SERÁ APRESENTADA POR INTERMÉDIO DO BANCO NACIONAL DO COMMERCIO DE SÃO PAULO S/A
Pagável na praça de São Paulo no dia 29 de fevereiro de 1956
JP.

Figure 46
Glass purchase invoice with CVB Vitrais Franco. Source: IB.

Inhabiting the Casa de Vidro, inhabiting an experimental project of modernity

The documents in the Bardi Institute archive provide clues as to the satisfactions and difficulties in occupying that modern, experimental project, whose promises of well-being and efficiency were not always kept. In the early years after its construction, the Bardis paid off the bills for the house's construction, attempted to exchange the stove that didn't work – one of the modern appliances in the kitchen and service area, often imported[51] - bought plants to comprise the garden and organized the pavement of its pathways in arenite stone[52]. Notes from the employees illustrate the daily routine in the house: the cleaning of the windows, the installation of the curtains and everyone's hope for rain to improve the look of the plants.

There were also difficulties in inhabiting that modern development: it had been necessary to build a well due to the lack of potable water in Morumbi, whose connections would only begin in October of 1955. In a letter to the director of the Morumby Real Estate Company, written by Lina in January of 1954:

I don't know if it's due to technical deficiency, error, a mistake or some other reason, there is no light, no power, no potable water and the pavement is not finished. Such is the case that I can't stay in my own home at that locale, the reason why I am residing in the Hotel Claridge[53].

Anna Carboncini, a former collaborator of Pietro's at Masp and now a member of the Administrative Council at the Bardi Institute, researched the Bardis correspondence in 1956 and found various pieces of news regarding the house. While Pietro was abroad at the moment (Pietro and Lina took several trips starting in 1953 to exhibit the works in the Masp collection in Europe), Lina reported on the garden and her contentment with it was evident. In the letters, they each referenced the construction of a possible wall to surround the house, which Lina avoided due to the high cost and also because the air of "untamed nature" offered by the "ravine" was pleasing to her.

In February, Lina also told of the need to replace a broken window in the main room. The documents in the archive show the payment of a rather high bill to Vitrais Franco, Companhia Comercial de Vidros do Brasil (CVB)[54]. According to Contier, this company was founded in 1940 with the objective of buying all the companies in the glass sector in the Brazilian market, including Casa Conrado in 1942, when, in 1943, Conrado III (Conrado Adalberto Sorgenicht) and his partners opened the aforementioned Vitrais Conrado Sorgenicht S.A. It is possible that the cracking of this glass resulted from the movements of the structure, which was still settling, according to the diagnostics realized by the technical staff of the project's research team, financed by the Keeping It Modern program.

Figure 47
Living room of the Casa de Vidro. Unidentified photographer. Source: IB.

All of these unforeseen occurrences seemed to make Lina reexamine her ideas. For instance, in April of 1956, she wrote to Pietro:

> Our house is very beautiful, the garden is marvelous, but today I would never think of making such a house, it is the residuals of my convictions regarding "undefined progress." Today I would make a house with a wood-burning stove made of stone, with no windows and surrounded by a large park, full of forest, the seeds I'd throw to the wind in the middle of the woods and the servants would be big primitive blacks; schools, schools, before machines there need to be schools; at our home today there's a stove that wastes gas, tomorrow it will be a toilet that doesn't flush[55].

In 1957, it was the defective boiler that needed maintenance, and they began to solicit estimates from specialized companies in order to replace the house's electrical installations, with a new power input panel and new three-phase lines, to upgrade from the former two-phase system that did not allow for the use of modern electrical appliances. In 1958, the water pump presented problems and the Real Estate Company requested that the architect construct a water tank with a motorized pump. It was that year that the couple purchased the third lot, expanding the garden and providing respiration at the back of the house.

Figure 48.
Dining room and fireplace of the Casa de Vidro. Unidentified photographer. Source: IB.

Also in 1957, Lina initiated the project for Valeria Cirell Piacentini's residence, the interiors of the Felloni Mattos medical office and the new headquarters of Masp. The very first sketches for the museum envisioned a large glass pyramid. Like the interiors of the doctor's office, they too relied on this materiality. But soon enough, new sketches for the museum proposed opaque facades, just like the facades of Casa Cirell and the house that Lina would design for the neighborhood of Chame Chame in Salvador, Bahia in 1958. Oliveira (2006) and Campello's (1997) readings of these last two houses interpret Lina's option for material expression that abdicated the expression of glass in favor of popular materials such as thatched roofs and plain stone walls with few openings. These walls presented river pebbles, tiles and objects encrusted in the plaster coating, apparently inspired by the work of Gaudí, who Lina admired and visited on a trip to Barcelona in 1957[56]. Concerning the differences between the Casa de Vidro and Casa Cirell, architect Carla Zollinger (2007) identified the former as a glass pavilion and the latter as a compound enclosed by opaque walls. Both Oliveira and Zollinger saw this change in the choice of materials as not necessarily indicative of a reversal of procedures in Lina's work: an opaque wall and transparent skin are elements that alternate in these projects in necessary equilibrium. The choice of material for the walls of the Casa Cirell was the same as in the new garage built on the grounds of the Casa de Vidro and the retaining walls in the garden, and they remain so to this day-- though it hasn't been possible to find a document signaling the exact date of construction.

Starting in 1958, after a period teaching at Fau-Usp and after an attempt to become a permanent faculty member, Lina accepted the invitation to give lectures and, subsequently, to teach in the architecture department at the University of Bahia School of Fine Arts. She was later invited

Figure 49
Living room of the Casa de Vidro. Unidentified photographer. Source IB.

Figure 50
Lina Bo Bardi at the living room of the Casa de Vidro. Unidentified photographer. Source IB.

to direct the state's Museum of Modern Art. In Salvador, she was responsible for the renovation of the Conjunto do Unhão in 1963, designated for the museum, also creating there a Museum of Folk Art with a design school and what she called the Center of Studies of Artisanal Work[57]. Zollinger (2007) demonstrates that, for the project of the Conjunto do Unhão's administrator's home, Lina planned a house that was entirely surrounded by stone, with a ceiling garden and the following annotation on the sketches: *Niente Vetri*, meaning "No Glass."

While in Bahia, and after the ill-fated transfer of the collection and schools of Masp to Faap, Lina continued the project for Masp's new headquarters. In August of 1964, she resigned from the museum's administration due to a number of internal reasons and confronted with the country's new political situation after the military coup d'état. The years she spent in Bahia remain as an important moment in the formation and encounter with Brazil. Lina returned to São Paulo[58] and gradually to the daily routine at the Casa de Vidro. The architect's light workload at that time is demonstrated by Lima (2013) who highlights that, during the period, her main activity consisted in creating executive drawings that would inform the construction of the new Masp. In the mid-1960s, with the building already under construction, for a number of reasons, she opted for the solution of a skin of glass, unlike the opaque facades in the studies, formed out of sheets six meters tall, "the first of these dimensions manufactured in the country," as Contier reminds us (2014).

Lina was in her fifties and Pietro had reached age 74. In the meantime, the trees in the gardens of the house had continued to grow, altering the microclimate and humidity on the grounds. The documents from this period reveal just minor maintenance, some problems with the water bills and

Figure 51
Floor plan, elevation, and detail of the porch thatch, ruff, and porch pillar. Valeria Cirell House, Lina Bo Bardi, Sao Paulo, 1958. Source: IB.

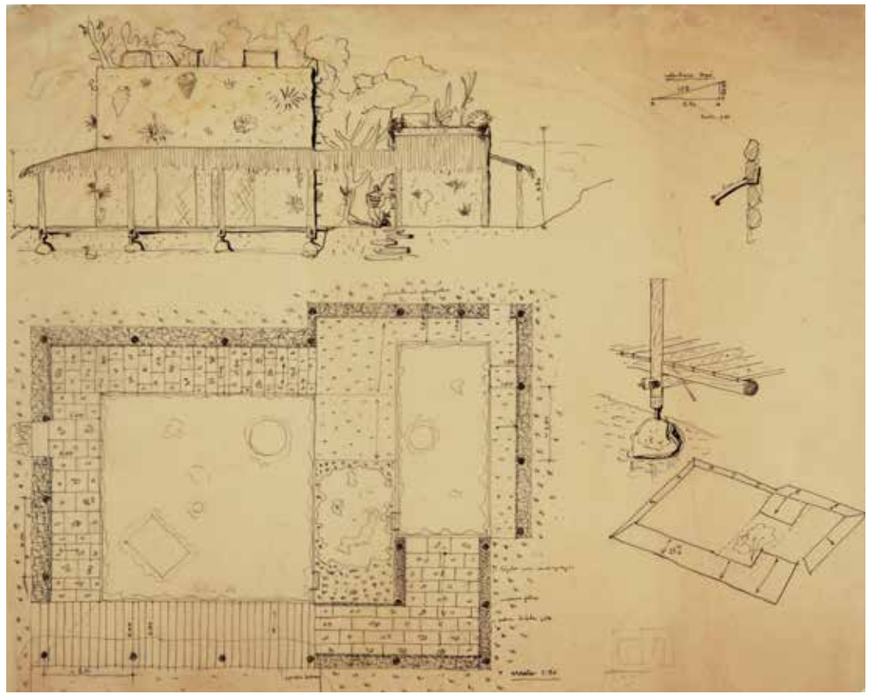


Figure 53.
Front elevation with precast panels and ingrown vegetation / Precast panel plan. Sao Paulo Museum of Art, Lina Bo Bardi, Sao Paulo, 1957-1968. Source: IB

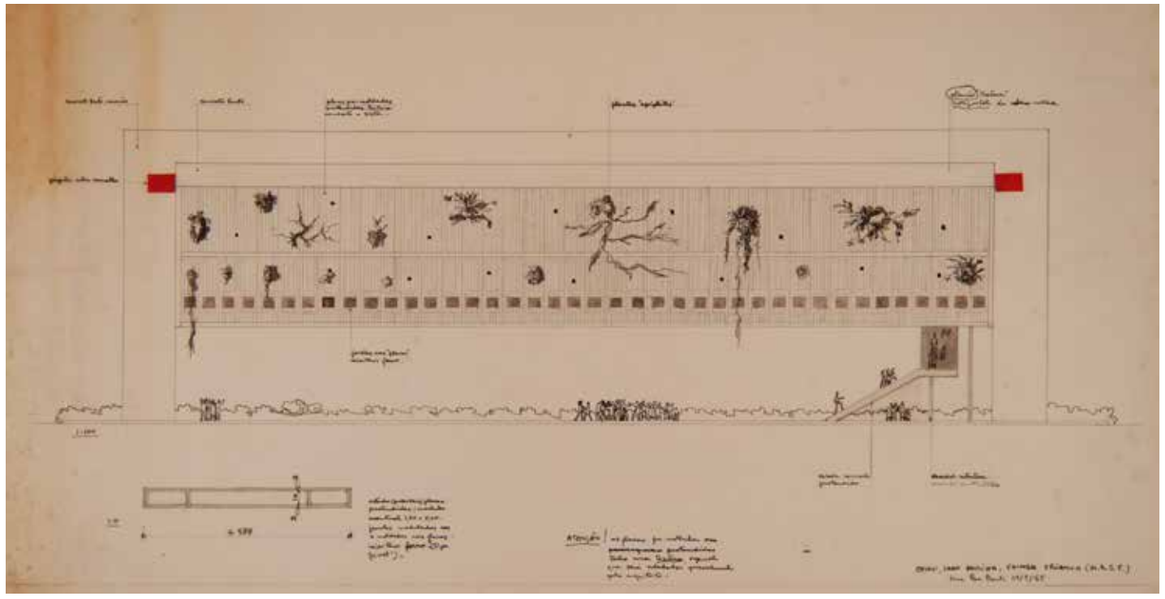
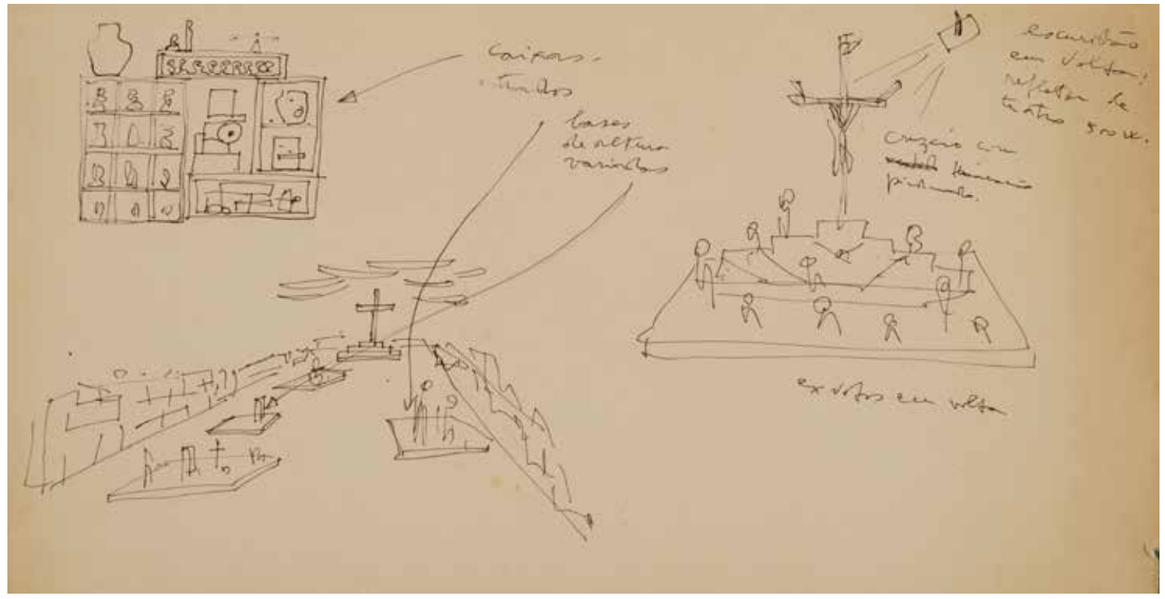


Figure 52
Lina sitting on the floor of the Casa de Vidro living room, Unidentified photographer, s / d. Source: IB.

Figure 54
Studies for the expography of the exhibition The Hand of the Brazilian People at MASP, Lina Bo Bardi, 1969. Source: IB



repairs to the water meter and the exhaust fan. Exceptionally, there was the need to cut down trees that were interfering with the Light Electric Company's power lines.

In 1968, Lina asked for her lawyer to cancel her participatory shares in the construction of the club that was set to be installed in the old Morumby Farmhouse, since, in her opinion, it contradicted the ideas of the "Companhia City" which, though not responsible for the development of the neighborhood, had perhaps inspired the idea of public, outdoor recreation areas.

Before the inauguration of Masp's new headquarters in late 1968, with the famous glass easels designed by the architect, Pietro opened his own private art gallery called *Mirante das Artes*, which also featured exhibit design created by Lina. The following year he released a magazine of the same name, for which the architect provided the graphic design. Also in late 1968, the decree known as AI-5 (literally "Institutional Act Number 5") was issued, giving immense powers to the presidency of the republic and resulting in an intensification of censorship and the use of torture. In 1969, the exhibition *A Mão do Povo Brasileiro* [*"The Hand of the Brazilian People"*], organized by Lina, opened at Masp's temporary exhibition gallery, displaying ideas developed during her time in Bahia and a representation of the country that placed value on folk art while simultaneously intending to expose people's harsh living conditions[59]. The exhibition countered the vainglorious patriotic visions of Brazilian technological production promoted by the regime. Right away, Lina took a position, in her own way, of resistance against the dictatorship, which investigated and prosecuted her in 1972[60].

At the recently opened Masp, a series of exhibitions would follow on varied themes in an active cultural season. Among them were shows on Candido Portinari,

Scandinavian Industrial Design, History in Comics and Mass Communication, all in 1970. These were followed by Claudia Andujar, Brazilian Furniture, Lasar Segall, Gregori Warchavchik, in 1971; Paul Klee and Wesley Duke Lee, Kengo Tange and the Piolim Circus, in 1972; African-Brazilian artists, Four Contemporary Masters: Bacon, Giacometti, Dubuffet and De Kooning, in 1973. In 1974, an exhibition was held on the work of Roberto Sambonet, a friend of the Bardis and former collaborator of the museum[61]. The following year, Lina organized the exhibit *Repassos*, along with painter Edmar de Almeida, about the work of women weavers in the region of Minas Gerais known as the "Triângulo Mineiro." In 1976, after a long period of nearly 10 years with very few projects, she designed a church, the Igreja Espírito Santo do Cerrado, in collaboration with the young architects André Vainer and Marcelo Ferraz, beginning a longstanding partnership, marked by the initiation, the following year, of the projects for the SESC Center Leisure at the Pompéia Factory, one of her most important works. Thus a new phase began in the architect's career, with architecture that leaned more towards glorifying simple, readily available materials capable of highlighting tectonics and the production process-materials that were generally opaque and without large sections of glass. In 1978, she designed the Santa Maria dos Anjos Chapel (also with Vainer and Ferraz), following this same line of architecture, and traveled to Japan, which would also influence her substantially.

In 1970, payment on the loans for the Casa de Vidro's land was finally completed and its deed was issued. Before 1978, when a new phase of construction work began on the Casa de Vidro, the archive's documents only testify to the renovation of the stove and the replacement of a few pieces of equipment.

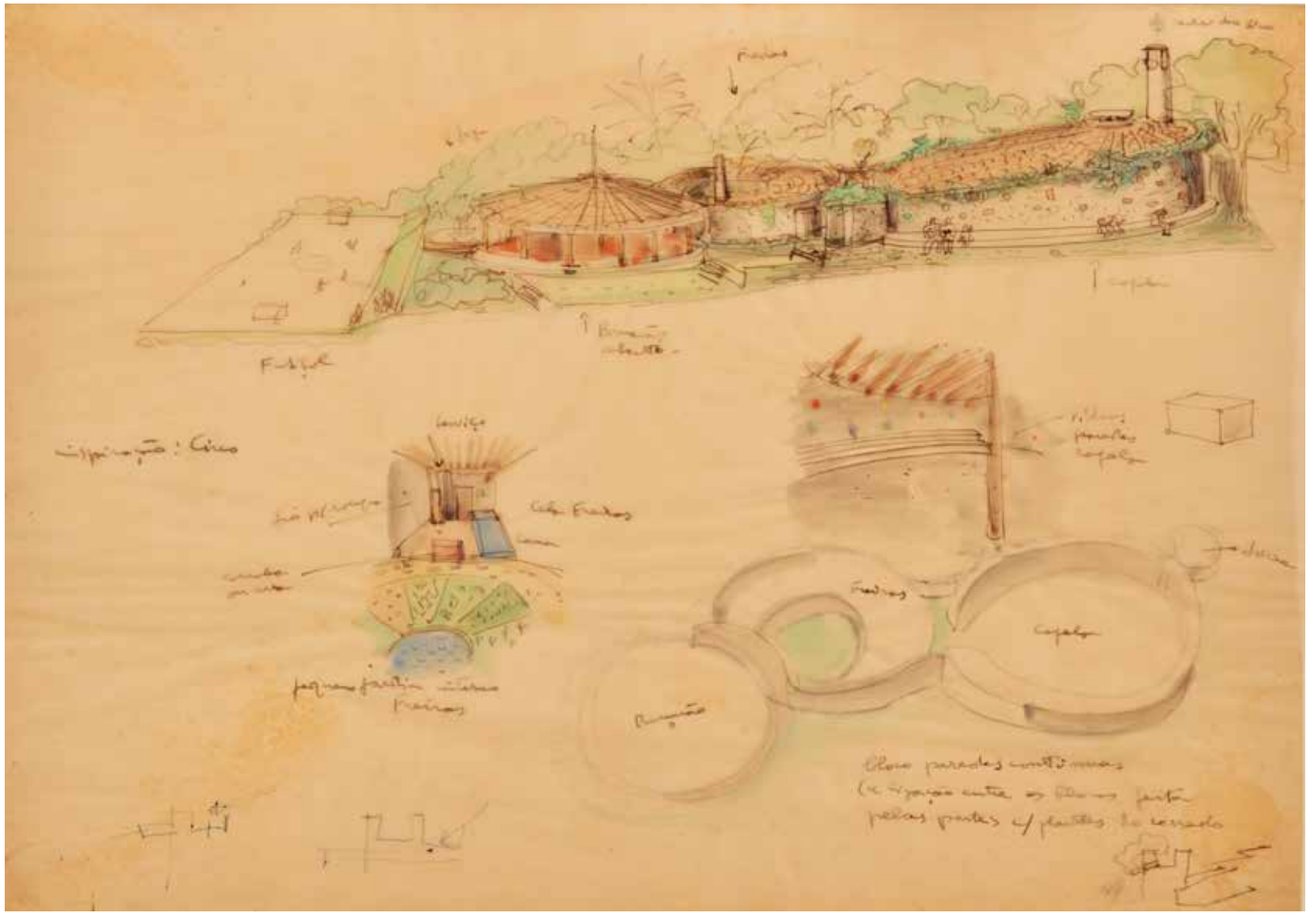


Figure 55
Perspective of the Espírito Santo do Cerrado Church project, Uberlândia, MG, 1976. Lina Bo Bardi with the collaboration of André Vainer and Marcelo Ferraz. Source: IB.

Figure 56
Front elevation of Santa Maria dos Anjos Chapel, Ibiúna, SP, 1978. Lina Bo Bardi, with the collaboration of André Vainer and Marcelo Ferraz. Source: IB.

Figure 57
External wall of the Casa de Vidro, Lina Bo Bardi, 1978. Photo Renato Anelli, 2019.

Figure 58
Wall of the SESC Pompeia Workshops, Lina Bo Bardi with the collaboration of André Vainer and Marcelo Ferraz, 1978. Foto Renato Anelli, 2015.

A new season of experimentation at the Casa de Vidro: maintenance, new constructions and landmarking

In 1978, the house once again became a place for experimentation. This phase coincided with an important period in the architect's career, characterized by the projects inaugurated in 1986, enjoying great success and bringing about new work demands. In these years, the house was a venue both for interventions in the existing structures, as well as new constructions that followed the architectural concept pursued by Lina in her recent works (as also happened years earlier, with the garage structure and the retaining walls), as well as the development of the Bardis' request to landmark the Casa de Vidro. In this period, major interventions were documented in the house's roof, windows and frames, points where great hopes had been placed in terms of performance in the original project. It is worth noting that this new season coincides with the slow reopening process under the military regime and, followed by the difficult and controversial restoration of democracy in the country

The first project of this phase began in March of 1978 and lasted until October of that year. It consisted in the creation of sidewalks and a wall of cement blocks along the property line. This wall had already been proposed and rejected in the Bardis' discussions of 1956, as verified by their aforementioned correspondence. It was also kept at a low height under the rules of the Morumby Real Estate Company, according to the contract from the 1950s. However, Suzuki gave a statement in which he mentioned that the city used to fine residents for not having a walled enclosure on their property.

The walls that were built follow a material idea similar to the one employed by the walls that Lina and her collaborators had been creating for the workshops at Sesc-Pompéia, where construction began in 1978, demonstrating contemporary experimentation in the two worksites. Interested in the acts of construction, they supported themselves on the idea of making the mortar used to connect the blocks overflow, avoiding waste through the bricklayer's gesture of collecting excess mortar with their trowels and making a groove between the pieces. This choice was able to effect a look of "poor architecture," as Lima christened it (2014), an architecture that strives for architectural simplicity, not one of "economic privation," but one that employs accessible means and those within reach, in addition to an emphasis on the evidence the work done by humans employed in the construction. This was an idea of architecture that rejected any sort of commitment to an image of high technology or an ideal of bourgeois sophistication, something very particular to that elite neighborhood, in favor of modest materials. The layout of the final filaments gave the wall the figurative look of a fortification or citadel.

Three years later, the first major renovation was executed on the roof. Its technical excellence, praised in Lina's writings shortly after the construction, proved to be less efficient than expected, or else it had aged worse than calculated. Almost 30 years after it had been built, the growth of the trees in the garden contributed to its deterioration, with fallen leaves clogging the gutters and branches breaking roof tiles, thus necessitating constant upkeep. Infiltrations in the main room's ceiling were the ultimate consequence of these problems. As such, in August of 1981, the roof was the subject of an inspection from Brasilit S.A. Brasilit Sociedade Anônima, indicating the number of corrugated sheets and ridges that needed to be replaced. The company stated that all of the roof's existing material had been produced by one of their competitors, Eternit, and that, having been manufactured long ago, the dimensions of the pieces were not coincidental. Ultimately, they referred the Bardis to the firm Telhados Paiva to execute the work described as a restoration of the roof. This firm thus supplied the specialized workforce to remove the corrugated sheets and replace the same roof, reassembled in the opposite direction, according to the manufacturer's norms. In addition to this work, Telhados Paiva subsequently endeavored to renovate all of the copper metalwork (including the exhaust chimneys and their caps). The work on the roof was completed in November, when the company conducted another inspection of the house and identified the cause of new infiltrations in the concrete gutters, suggesting arrangements for repair. Taking advantage of the renovation process, the following year, a "Franklin" type lightning rod was installed.

In 1983, there are indications of new maintenance interventions concerning what is referred to as a general revision of the casements, with indications of replacements of the profiles (of folded sheet for "iron frameworks," as listed on a budget estimate realized by Serralheria Aicaz[62]). The same year, the wood parquet flooring was scraped and reformed and piping was installed to drain the septic tank. In 1984, there are indications that work was done on doors (probably the garage doors) and the caretaker's house.

Between 1985 and '86, when Pietro had turned 85 and Lina 71, the Bardis enjoyed some well-deserved fruits of their labor: Pietro was celebrated in a special issue of "Casa Vogue," having collaborated with the magazine's editor since the late 1970s, and Lina received increased attention due to the success of Sesc-Pompéia, which was featured in a growing number of publications.

Figure 59
Vogue magazine, cover of the special issue on Pietro Maria Bardi. Feb. 1985. Source: ECA-USP Collection.

Figure 60
Lina Bo Bardi at the Casa de Vidro wearing a dress made by Flávio Império, 1984, Photo: Vic Parisi. Source: IB.

With the new projects that she came to receive and, according to Suzuki, due to the loss of places to set up onsite offices (as was the case with Sesc-Pompéia), she decided to realize a novel building in the house's gardens: a work office for the architect and her collaborators, a small pavilion formed of dozens of wooden pillars that supported the elevated pinewood floor. Covered by a pitched roof, it also features an attached brick block for the kitchen and bathroom, with a ceiling garden.

A sketch dating from June 10th depicts the idea of architecture based on the choice of materials and in the simplicity of the construction process that ideologically carried out the quest for "poor architecture" which Lina undertook. The sketch features canal ceramic tiles, a few glass tiles, a eucalyptus structure, Madeirit walls, Japanese sliding doors with dual nylon screens, wood floors. Without no gutters, the water from the roofs should be stowed on the ground through a draining process of rolling pebbles, allowing for a curtain of water on rainy days and avoiding accumulation that would lead to infiltrations. A drawing on letterhead paper by Roberto Rochlitz, an engineer who worked on the Masp project as part of the firm Figueiredo Ferraz, shows the details of the iron prongs in the concrete foundations.

Marcelo Ferraz, who also authored the project for the "little house" along with Vainer and Lina, highlights the extent to which it was the fruit of the architect's mature work[63]. Throughout the 15 years in which he knew her, she used to always say that if she were to make the Morumby House all over again, she would do it completely different, with other materials, with eaves. He personally witnessed, while she was still alive, at least two repairs on the windows (always substituted with the use of simple glass) and recalls that it was common to see cracked glass in the corner of the main room, sustained by adhesive tape[64].

Ferraz recalls that Lina asked her collaborators to find a place in the garden with a clearing for the office and suggested that they build a little house with a roof like the Santa Maria dos Anjos Chapel. The structure, built in a matter of days, used concrete footings made out of large paint cans, a popular practice on construction sites. In this can, the pilotis of treated eucalyptus were encased, and followed by the assembly of beams and rafters in commercial dimensions. The purpose of the stand with simply fastened shelves, central to the project, served to provide structure and aimed to reduce strain, being that the pilotis were initially only planned for the sides. As such, it served to simplify the construction and unified the architecture and the furnishings.

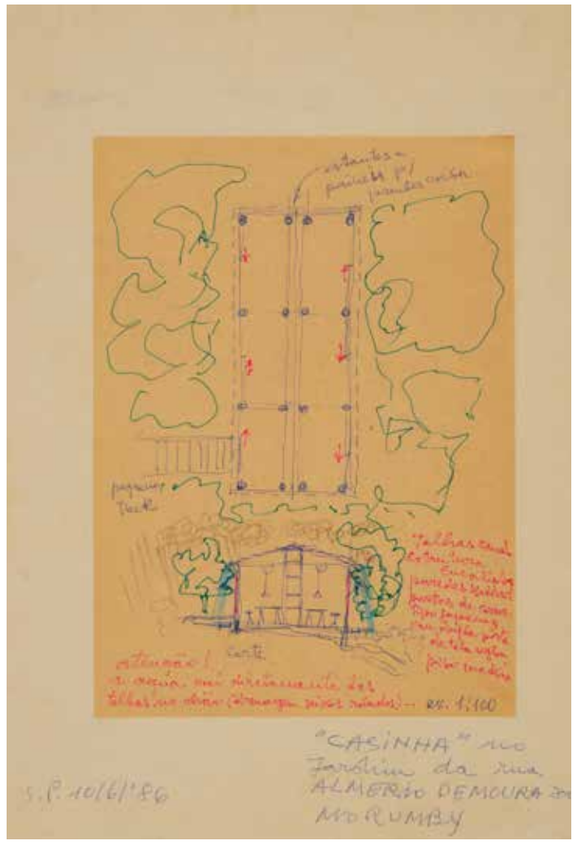


Figure 61
Sketch for the studio – Casinha (little house) design. Lina Bo Bardi, 1986. Source: IB.

Ferraz and Vainer were the authors of the project's details. With the help of some construction workers from SESC, they built the "little house" in around 20 days (with no time for photographic documentation) using materials bought at the neighborhood construction store, given its simplicity, rationalizing popular procedures and putting Lina's ideas into practice, in a manner very different from the efforts employed to execute the Casa de Vidro.

Lina would rarely go down to see the work in construction, more often her collaborators went up to have meetings inside the Casa de Vidro, as Suzuki also recalls. Inside the little house, the projects were planned for Salvador's Historic Center and, after Lina's death, it was used temporarily as the Institute's headquarters.

The proportions of this small pavilion with no glass (1:2) and the bracing through the doors' slats are striking aspects of the structure's composition. When open, the doors allow, in precisely the same way as the Casa de Vidro, for a direct relationship with the surrounding greenery, with that nature constructed over the years.

At the same time of the planning of the "little house," on request from the architect herself and supported by Pietro, the process soliciting the landmarking of the Casa de Vidro and its interior collections to the Council for the Defense of Historic, Archaeological, Artistic and Touristic Heritage of the State of São Paulo - Condephaat was initiated. In September, the process was approved by the Council and its inscription was recorded in the book of Historical Heritage in 1987.

Also in 1986, Lina's jewelry was stolen from the Casa de Vidro. The following year, she designed a new project for the gate, planning for red paint and a structure with a top guide, evocative of the image of a great work of engineering. Suzuki recalls that before the current one, there was a low gate which opened outwardly.

The new gate was constructed by locksmith Durval Alijarte, who was also responsible for the rails on the garden walkways, in an artisanal manner, molding them in loco with a kiln to adjust the design to the curves. Alijarte's services also extended to the house's framework, which he repaired, cleaning off the rust and painting it.

The receipt for the purchase of four 10-millimeter crystals from Casa Santos Colocadora de Vidro S/C Ltda and the receipt for the payment of 30 installations and labor indicate new glass replacements that year, a recurring problem which was also registered in documents from 1993, 2003, 2007, 2010, 2011, 2012 and 2015.

With the maintenance work on the windows, the Bardis took advantage to realize the manufacture and installation of new linen curtains in the main room, unlike the original plastic, as well as the pleated "lonita" curtains in the bedrooms[65].

The documents related to these years marked by the Bardis' dedication to the house also reveal a mobilization for the maintenance of the characteristics that they intended for the neighborhood: also in 1987, in virtue of the news that the little square in front of the house was being considered to be the locale for a police station, they strove to collectively prevent this from happening, sending a letter to Cláudio Lembo, then Secretary of Extraordinary Business at City Hall. A commission was then formed out of local residents to tackle the issue and Pietro was part of it. Among the justifications, they stated that this was an area maintained by residents, that it was a rare example of original forest and a bird sanctuary. In a text written by the residents, they listed the species of birds, mammals and trees and highlighted the Chapel of São Sebastião, maintained by the Austrian Consulate and located in front of the Casa de Vidro.

When the locals went to deliver the letter to the Secretary, they were informed that, due to the amount of phone calls, phone calls from elites, no less, he had received regarding the issue, that he had decided, along with the mayor, to take the square off the list of locales being considered for the police stations, asking only that the residents come up with a name for it in order to register it with the city. They then organized a competition, whose committee was comprised of Pietro, Roberto Duailibi, Flávio Pécora, Conrado Balducini and Mário Ágaci[66]. This is the last document on the subject, stored in the Bardi Institute archive. A decree from September of 1987 finally officialized the name of the square as Praça Poeta Carlos Drummond de Andrade.

Figures 62, 63, 64
Studio on the grounds of the Casa de Vidro, 1986. Lina Bo Bardi with the collaboration of André Vainer, Marcelo Ferraz. Photo Marcelo Ferraz. Source: IB

Figure 65
Elevation of the Casa de Vidro's Gate, 1987. Lina Bo Bardi, Watercolor, ballpoint, graphite, on offset paper. Source: IB

Just as the request to landmark the house represented an initiative to preserve the project for posterity, in 1990 the Bardis founded the Quadrante Institute, designated to uphold the memory of their cultural project. According to the minutes of the general assembly of the Institute's constitution, held on May 3rd of that year, those present were Pietro, Lina, Graziella Valentinetti, Lina's sister, Fábio Luiz Pereira Magalhães, Modesto Souza Barros Carvalhosa, José Mindlin, Renato Requixa and Renato Magalhães Gouveia. The Institute's objectives were to develop cultural activities and studies related to the history of art and architecture, with the house as its headquarters.

In the 1980s, the Bardis also entrusted Suzuki with the construction of the new water tank (which exists to this days), executed in a hurry over the course of a single weekend, to replace another one whose wooden structure had collapsed.

The last document in Lina's archive, stored at the Bardi Institute, describes new repairs on the house's roof, executed in 1991. The same year, the house was landmarked by the Municipal Council for the Preservation of the Historic, Cultural and Environmental Heritage of the City of São Paulo - Conpresp.

On March 20, 1992, Lina Bo Bardi passed away inside the Casa de Vidro.

The following year, then renamed the Lina Bo and Pietro Maria Bardi Institute (substituting the former Quadrante Institute), they began discussions and actions to solve the physical problems of the residence (which always included Suzuki's collaboration), at the same time initiating a major campaign to promote Lina's work, led by Ferraz, who through exhibitions and publications contributed to her fame all over the world.

Also that year, Suzuki coordinated a sweeping, complex renovation as Pietro was ill, still living in the house. Several windows were replaced, and the casements were disassembled, sanded, painted and reassembled. The support walls were reformed, as was the flooring in the gardens. The outside and inside were both repainted, and the broken roof tiles were replaced.

In 1995, Pietro formalized the donation of the House to the Institute in his will. He passed away on October 10, 1999. His and Lina's ashes were entombed in the House's walls.

Figure 66
Lina Bo Bardi and Pietro Maria Bardi at the Casa de Vidro, 1989. Photo: Marcelo Ferraz. Source: IB

Figure 67
Interior of the Casa de Vidro living room in 1998. Photo: Arnaldo Pappalardo

The Casa de Vidro and the Lina Bo and P. M. Bardi Institute: experimentation for preservation

With the Bardis dead and the house donated to the Institute, which also assumed the maintenance and recuperation of the cultural heritage site, it became necessary to envision the adaptations that the new use would begin to solicit, little by little, anticipating public visitation, safety measures and accessibility. It was also necessary to recognize, organize and protect the virtually intact archive, stored inside the house.

In 2003, Suzuki executed a project to renovate the residence and adapt it to serve as headquarters for the Lina Bo and P.M. Bardi Institute. The proposal stipulated the full maintenance of the complex, the reconstitution of the library and the kitchen in glass, the modification of the use of the dormitory and service area blocks, including wheelchair access, the installation of a small auditorium in the storage area on the ground floor, identical to the volume in the garage, the construction of a new water tank, the transformation of the "little house" into a teahouse-bar and the construction of a guard booth and bathroom for the security guards in the garage. It also provided for upkeep and necessary renovations of the plumbing and electrical installations, termite extermination, replacement of the windows, metalwork, waterproofing, a conservation of the forest and original pathways. Suzuki proposed a walkway on the rose patio to avoid the public passing through the kitchen, even while envisioning it as part of the visitation area. The project received positive evaluations from preservation agencies, a favorable report from Conpresp, approval from the Municipal Department of Historical Heritage and Condephaat and was submitted to the Ministry of Culture to obtain sponsorship through the cultural incentive legislation known as the Rouanet Law. It then went on to the fundraising phase, but proved unsuccessful in this attempt and could not be implemented.

Another previously mentioned serious problem that had to be confronted was the existence of termites that had damaged the house's furniture and trees in the garden. Since 1993, there have been documented actions taken by the Institute to tackle this issue, involving, for example, evaluations by Robert Klestler, who specializes in methods of exterminating insects in wood, and Brazilian technicians such as Antonio Tadeu de Lelis, a professor from the Institute of Technological Research of the State of São Paulo - Ipt, and restoration professional Yacy-Ara Froner Gonçalves. But Pietro's hospitalization at the time led to a suspension of communication on the matter.

New efforts to combat the termite infestation reappeared in documents in 1998, in Suzuki's aforementioned proposal in 2003, as well as in 2005 and 2006. In 2007, this arduous work was undertaken, a process that lasted two years, carried out in collaboration with the Ipt. It involved termite extermination in the attached furniture, shutters, closet structures, books and publications, small pieces and furnishings made of wood, frames and supporting structures for works of art. Objects were sent to the Ipt to be fumigated inside gas and sanitation chambers. Additionally, anoxic atmosphere (i.e. low oxygen) chambers were built in the Bardi Institute's storage area in order to exterminate termites in gilded and polychrome pieces of antique furniture. Part of the book collection was also disinfested at the Institute of Nuclear Energy Research at the University of São Paulo – Ipen – Usp), in a chamber bombarding them with low doses of nuclear energy.

The trees in the garden were surveyed, diagnosed and treated, including those at risk of falling (with a report presented in 2009). Insect baits were installed, tree trunks were painted and procedures for managing and monitoring them were implemented, with regular removals of fallen or rotten plant material, mainly branches and leaves. At the first of these removal sessions, four dump trucks were filled with debris.

The mobilization of technology from the Ipt laboratories turned the house into a hotbed for applying advanced methods of heritage site maintenance and preservation. The termite extermination efforts and the need to send pieces to the Ipt, along with the resulting clearing of the closets, shelves, drawers and entire rooms[67], allowed the Institute to become more familiar with its own archives and reorganize them, as demonstrated by statements from Anna Carboncini and Mallu Villas Boas, both of whom participated extensively in the process.

Between 2007 and 2008, another maintenance project was executed, headed by Suzuki, which once again included the replacement of the glass, treatment of the casements in the main room and metal sheet fencing, as well as the execution of a new casement in the kitchen[68]. There is documentation concerning the restoration of the metalwork in the slab's reinforced concrete structure and the conditions of the steel pilotis were verified, according to an inspection conducted by the engineer Rochlitz[69].

Also in 2007, the Cultural Heritage Consulting Council for the Institute of National Artistic and Historic Heritage - Iphan declared the Casa de Vidro to be a national cultural landmark, including its exterior gardens and works of art, furniture, design and objects. In 2013, there was a notification that the provisional landmark status was to be expanded to the collection of works of art, furniture, design and objects and, in 2014, the isolated landmark status of the edification was ratified by the sectorial chamber, along with the grounds upon which it stands.

The glass tile floors were restored in 2009, sponsored by Vidrotil, the São Paulo-based manufacturer of artisanal tiles and mosaics which has been in business since 1947, responsible for various modern murals in the city, and known for having developed its own techniques.

From 2009 to 2015, some minor maintenance work was done on the house's plumbing (exchanging the fastened pipes), while constant repairs took place on the roofs, mainly replacing broken tiles, in addition to the annual painting and the maintenance protocols of disinfestation that includes checking the insect baits and cleaning the gardens. The furniture was also restored, including the Florence double vanity and the Venetian arch, the bureau, the six chairs in the main room, the shelves in the library, the prototype of the acrylic for the chair that became known as Bardi's Bowl, the finger of the white marble sculpture Diana (whose date and authorship differ depending on the source), and the 1949 Sambonet painting *Black with mug*. Additionally, the studio's wood doors were restored, as was the support wall of the Caretaker's House, forever hampered by the humidity.

Aiming to preserve the house's archive and allow for the public to consult it, the Institute executed two projects financed by the State of São Paulo Research Support Foundation – Fapesp and coordinated by Professor Renato Anelli, as part of a research aid program designated for the infrastructure and archives[70]. The resources were utilized to carry out a complete renovation of the Casa de Vidro's electrical installations, purchase furniture and systematize the archive. The process of cataloging the latter was also supported by Petrobrás and Caixa Econômica Federal through the cultural incentives law, which, along with the Fapesp project, promoted the renovation of the archives, optimizing the occupied area with sliding cabinets, and the development of the databank and website[71].

The project of renovating the electrical installations sought to respect the House's characteristics, having realized two visible alterations, with the date of its execution registered: the power input set-up, comprised of a post and a standard Eletropaulo meter, installed under Suzuki's supervision, and the packaging tubes for the power supply wiring that had to cross the garden, running along the surface of the terrain in order to avoid interfering with the existing roots and support walls. The new circuit breaker panels were necessary due to the Institute's new equipment and they anticipate a future increase in activities. There was some difficulty in passing the new wiring through the existing tubes imbedded in the house's interior due to the thicker gauge, which required some removal efforts. It was possible to utilize all the existing electrical socket boxes and light switches, even those originals made of tin located on the living room floor.

In 2016, with the project financed by the Getty Foundation as part of their Keeping It Modern Program, a perspective of the house as a place for conservation research emerged.

The maintenance of the garden and the difficulty in dealing with its dynamics, the constant breaking of the glass, infiltration problems in the roof showed that the points upon which the project placed emphasis, whether or not they are connected to the promises of modernism, brought unforeseen problems, and they deteriorated faster or were less efficient than expected. At the same time, the reinforced concrete structure remained in good conditions. The purpose of the study of the reasons behind the choice of materials and their performance over time based on the documentary archives hopes to provide meaning and guide the future actions of intervention. The projects, constructions and maintenance work executed at the House over the years demonstrated the extent to which it has been a laboratory for the creation and conservation of modern architecture. The history of the complex's transformations during the Bardis' lives shows how Lina revised some of her positions without giving up a modern attitude. Furthermore, its hybrid character and the dilemma between confidence in technological progress and the use of traditional techniques characterized the place's trajectory, reinforcing the complexity of the modern experience itself. Ultimately, it reveals the Casa de Vidro's vocation in terms of experimentation, and its coherence and dialogue with Lina and Pietro's way of thinking, being that they emphatically controlled the project, its maintenance work and the destiny of its modern legacy.

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Interview with Marcelo Suzuki, conducted in person with Aline Coelho Sanches, November of 2017, São Carlos.

Interview with Anna Carboncini, conducted in person with Aline Coelho Sanches, February of 2018, São Paulo.

Notes

1 The nickname Casa de Vidro [Glass House] given to the Bardis' home in Morumbi was utilized publicly, as far as we have been to verify, for the first time by Gio Ponti in his article on the work published in the February, 1953 issue of "Domus". In the text, he declared that this was the name which residents of the nearby neighborhood used to refer to the house that he had personally visited the previous year. International circulation of the magazine resulted in the name's use in other publications, as well as its adoption by the Bardis themselves, who had initially called it the *Morumbi House*.

2 There is an important bibliography regarding modern Italian architecture's relationship with rural architecture. Recommended reading includes Sabatino (2010), Lejeune and Sabatino (2010). This relationship is addressed in sections of Corato (2016).

3 I would like to take the opportunity to thank those interviewed for their openness. First of all, Lina's former collaborators who frequented the house and had knowledge of its daily routine, Marcelo Suzuki and Marcelo Ferraz. Pietro's former collaborator at MASP, Anna Carboncini. Employees and ex-employees at the Institute, including Malu Villas-Boas, Julia Paccola, José Ribamar dos Anjos Santos, Marcella Carvalho and Célia Arroio da Silva, who worked for Pietro.

4 To the thousands of documents of the most varied nature that I studied at the Lina Bo and P.M. Bardi Institute, I add others from the archives of the Centro Studi and Archivio della Comunicazione – C SAC in Parma (*Fondo Pier Luigi Nervi*); from the project archives at the Library of the University of São Paulo College of Architecture and Urbanism – FAU-USP - the Gregori Warchavchik Archive - , from the Historical Archive of the Museum of Art of São Paulo Ð Masp, from the archives of the heir to Engineer Tullio Stucchi, from the personal archives of architect Marcelo Suzuki (an active collaborator on this research project and a former collaborator of Lina's), from the General Archives of Processes at São Paulo City Hall and, finally, from the archives of periodicals at the Libraries of the University of São Paulo São Carlos School of Engineering – EESC-USP, the College of Architecture and Urbanism - FAU-USP, the School of Communications and Arts - ECA-USP and the Mario de Andrade Library. I also was able to access documents found or systematized by other researchers, like the correspondence between Pietro and Nervi included in the archives at MaXXI (*Museo Nazionale delle arti del XXI secolo*) in Rome, studied by Gaetano de Francesco, the correspondence between Pietro and Lina included in the Bardi Institute's Archives, researched by Anna Carboncini, and the documents concerning the landmarking of the house from Iphan and Condephaat, researched by Ana Lucia Ceravolo. In developing my studies on the historic documentation of the Casa de Vidro, I received help from two undergraduate research fellows at IAU USP, Amanda Basso Morelli, who for over a year undertook the task of carefully systematizing published primary and secondary sources, and Laura Freitas Pinheiro, who systematized with precision some of the primary sources I had collected. Lastly, I benefitted from the brief, voluntary and attentive collaboration of Leticia Becker, then an architecture student at Mackenzie.

5 As a result of the research, I am also writing new texts about the House's critical success along with Amanda Basso, as well as an attempted reconstruction of the uses and everyday life in the interior of the structure over time.

6 For more information on these immigrants in São Paulo, see Arruda (2005).

7 For more on Studio d'Arte Palma in Rome, see Pozzoli (2016).

8 I'm referring to Lima (2013), Tentori (2000) and Morais (1994). This information appears in the presentation of the history of MASP realized by Pietro in Bardi (1992).

9 I addressed Pietro's relationship with the past, in terms of the defense of modern art in Corato (2013) and Corato (2016).

10 For more on Lina's biography and an interpretation of her activities in Italy, see Lima's writings, op. cit.

11 For more information on Pietro's life in Italy, see the work of Tentori, op. cit. and (2002); Rusconi (2009).

12 I addressed this argument in Corato (2016).

13 For more, see *Daniele Calabi* (1992) and Anelli (1999).

14 Lina Bo Bardi Collection, Bardi Institute, Casa de Vidro Documents 01.0107.1.

15 For more on the neighborhood and Bratke's house, I recommend reading Dall'Alba's dissertation (2017).

16 For more information on the architect Gregori Warchavchik, see Lira (2010) and Anelli (2001).

17 For more on the history of the IAC, see Leon (2014).

18 Here, I refer to Campello (1997) and Lima (2013).

19 I am referring to Campello, op. cit; Oliveira, op. cit and Carrilho (2005).

20 I'm referring particularly to *Progetto dÐum edifício dÐespozion*e, created with engineer Guido Fiorini in 1935.

21 The CISAV, in turn, would send Pietro a copy of a magazine advertising the material, "Lastre di Vetro e Cristallo," and requested his opinion on it.

22 For more on the *Mostras Didáticas*, see Politano (2010).

23 Oliveira (2006) also illustrates the relationship between the two devices.

24 Anelli (2014) and Corato (2012 and 2013) have written about their allegiances to Italy's exhibit design culture.

25 For more on this, see Sanches (2003) and Carboncini (2018).

26 See Corato (2012).

27 See Oliveira (2006).

28 See Campello (1997).

29 Letter from Pier Luigi Nervi to Pietro Maria Bardi, 11/25/1950. Document archived at the Fondo Nervi-4.DID serie Ricerca e Didattica 1958 - 1965 R05/01 Corrispondenze, indirizzi, Sao Paulo, Archivio Nervi MaXXI di Roma (research of Gaetano de Francesco). A copy of the same card is archived at the MASP Library and Center of Documentation, 1950, Course on Reinforced Concrete Pl Nervi Box 1, Folder 4.

30 Letter from Pier Luigi Nervi to Pietro Maria Bardi, 12/13/1950, Rome, Document archived at Nervi-4.DID serie Ricerca e Didattica 1958 - 1965 R05/01 Corrispondenze, MaXXI, Rome, research Gaetano De Francesco, my translation.

31 Fondo: Nervi, Pier Luigi./"Villa Bo - Bardi a San Paolo / P. L. Nervi [s.d.] (1 progetto (1 cartella) : 13 lucidi, 8 copie eliografiche, 11 copie eliografiche con interventi manoscritti)/. Location: Biblioteca delle Arti e dello Spettacolo, Centro Studi e Archivio della Comunicazione (CSAC), Parma.

32 I got the chance to discuss the project with engineers on the team of the Casa de Vidro project, at Icon of Modern ARchitecture, especially Prof. Marcio Minto Fabricio and PhD candidate Júlio Cesar Franco Júnior, whom I would like to thank.

33 I was able to trace the continuity of Construtora down to recent times, as well as the sequence of its owners, thanks to generous contributions from a number of engineers who worked there. Unfortunately, despite the efforts, I was unable to access their archives, which certainly would offer new important documents to this work.

34 The Lina Bo Bardi Archive, Bardi Institute, Casa de Vidro Documents 01.0143-8.

35 Thanks to engineer Fernando Stucchi for his assistance in this study and the material sent.

36 In 1952, Tullio Stucchi was promoted chief of the technical office and chief general supervisor of projects, a position he would hold until 1969.

37 The engineer's resume lists him as the author of the project. In Falbel and Ohno (2003), it is stated that the structural project was studied in collaboration with Czech national Walter Neumann, head engineer at Sociedade Comercial e Construtora S. A.

38 As listed on the engineer's resume, kindly sent to me by his son.

39 Tullio Stucchi did not include the Casa de Vidro on his resume, perhaps because of its small dimensions, or maybe because it was adapted from Nervi's project.

40 It's worth noting that Stucchi was also the author of the calculations for the Casa Verde Bridge in Freguesia do Ó.

41 Lina Bo Bardi Archive, Bardi Institute, Casa de Vidro Documents 01.0104.1-3.

42 Marcelo Suzuki's statement to Aline Coelho.

43 The Bardi Institute's archives do not contain photos of the construction of the House, just as no Daily Register of the construction has been found thus far. Marcelo Suzuki, a collaborator of Lina's, said in a statement that the architect always made sure to have a Register of this sort, as verified in the project for SESC-Pompéia. According to him, this register of the Casa de Vidro must have gone missing. To remedy this absence, I constructed a chronological synthesis of the main facts concerning the construction of the house based on the Lina Bo Bardi Archive, which is not originally organized by date or theme, and the so-called post-mortem archive stored at the Institute and still yet to be catalogued or organized. The objective of this work was to provide subsidies for new historical interpretations, but overall, to bring important information to light concerning the work of identifying pathologies and the preventative maintenance of the building and its complex realized by other teams on this research project for the House's conservation, financed by the Getty Foundation's Keeping It Modern project. The construction of this "Daily Construction" register thus organizes part of the memory of the complex based on the collection of documents contained inside the actual house, to be subsequently made available by the Bardi Institute.

44 Lina Bo Bardi Archive, Bardi Institute, Casa de Vidro Documents, 01.0104.5

45 Lina Bo Bardi's letter to Sociedade Comercial Construtora, São Paulo, January 28, 1952. Lina Bo Bardi Archive, Bardi Institute, Casa de Vidro Documents, 01.0104.4.

46 Acervo Lina Bo Bardi, Instituto Bardi, Documentos Casa de Vidro, 01.118.4

47 Lina Bo Bardi Archive, Bardi Institute, Casa de Vidro Documents, 01.0101.07

48 For more information on Casa Conrado Sorgenicht, see Mello (1996).

49 According to Mello (1996), the panel was imagined as a didactic work, developed by several Brazilian architects. Lina had created the panel in the background and Pietro had received support from Claudia Andujar.

50 Statement made by Marcelo Ferraz to Aline Coelho on July 25, 2018. It is worth adding that, according to Contier (2014, p. 234), at MASP, they had planned to use glass imported from the United States by CVB, but the glass actually used ended up being from the Brazilian-based Companhia Produtora de Vidro (ProVidro), a fact in which Lina had taken pride.

51 Lina Bo Bardi Archive, Bardi Institute, Casa de Vidro Documents, 01.0105.05/1.209.12.

52 Lina Bo Bardi Archive, Bardi Institute, Casa de Vidro Documents, 01.0144.03-04. This is an invoice to Mr. Pietro Maria Bardi that indicates the "Supply of three trips of granite rock and 408 ml of arenite slabs made in roads in your garden, with the respective manpower."

53 Lina Bo Bardi Archive, Bardi Institute, Casa de Vidro Documents, 01.0104.09. This is a letter from Achilina Bo Bardi to Luiz Oliveira de Barros Ð Director superintendent of the Morumby Real Estate Company - São Paulo, January 13, 1954.

54 Lina Bo Bardi Archive, Bardi Institute, Casa de Vidro Documents, 01.0133.13 and 01.0133.14.

55 Bardi Institute Archive. Letter from Lina to Pietro, 04/03/1956. Consultation, research and translation from the Italian by Anna Carboncini, kindly made available for this project.

56 For more on the importance on her trip to Barcelona, see Bierrenbach, (2003).

57 For more on Lina's time in Bahia, see Pereira (2008) and Lima (2013). About the project for Unhão and its restoration, see Suzuki (2010) and Ceravolo (2013).

58 After a short period in Rio de Janeiro, according to Lima (2013).

59 For more on the exhibition, see Latorraca (2014) and Corato (2016).

60 For more on this period and these occurrences, see Lima (2013).

61 For info on Roberto Sambonet and MASP, see Corato (2012), Camesasca (2006) and Morteo (2008).

62 Lina Bo Bardi Archive, Bardi Institute, Casa de Vidro Documents, 01.0192.4

63 Statement by Marcelo Ferraz to the author realized in July of 2018.

64 In his statement, Ferraz also says that he was responsible, on request from Lina and Pietro, for the small project of installing the little shards on the access ramp to the house, using a box of tiles that Lina had brought home from her time in Bahia, from the late 1950s to the early '60s.

65 According to the estimate from July and August of 1987. Lina Bo Bardi Archive, Bardi Institute, Casa de Vidro documents, 01.0196.04 and 01.0196.05.

66 Lina Bo Bardi Archive, Bardi Institute, Casa de Vidro Documents, 01.0196.02.

67 According to reports from 2008, the process included documentation of the conditions of the house and its objects through photos and surveys.

68 Lina Bo Bardi Archive, Bardi Institute, Notes from the Institute's "Livro Razão," October of 2017.

69 According to Anelli (2013).

70 The first project was christened "Support for the institutional infrastructure for the research of the Lina Bo and Pietro Maria Bardi Institute archive" and the second, "The Lina Bo and P. M. Bardi Institute Archive: Cataloging, digitalization and the assembly of the online databank."

71 These works were concluded in March of 2013, when the Lina archive databank and a digital reproduction of a substantial part of the iconographic material became available for consultation online.

2.4 The Casa de Vidro: architecture, art and nature[1]

Renato Anelli

The Casa de Vidro [Glass House] and its garden form an essential set for the analysis of the relation between architecture and nature in the work of Lina Bo Bardi. When giving a lecture in 1958, the architect reveals the parameters that guide her in this relation, establishing two categories – "natural architecture" and "unnatural architecture":

> An unnatural architecture [...] architecture that "frames" nature, such as [...] an object on a table, an architecture that "observes" nature but gives it no confidence and can be both here and over there.
>
> A natural architecture [...] not limited a priori, an "open" architecture that accepts nature, which approaches with caution, which seeks to mimic itself with it, as a living organism, an architecture that comes to assume sometimes forms of almost mimicry, such as an iguana on stones in the sun. (BARDI, 1958)

While recognizing certain interactions with the topography and tree clumps existing on the ground when it was conceived, the Casa de Vidro fits into the first definition. On the other hand, the garden, the paths and the new constructions made in the following years define themselves like an architecture that mimics the nature. The relationship between architecture and nature goes through the understanding of its positioning between the two categories, addressed in texts still in Italy (BARDI, 1953), and was transformed during the forty years the architect lived in the construction. Main house, garden and annex buildings express such transformations, offering the possibility of being interpreted as a historical narrative.

The Mediterranean in the tropics

When presenting the first house of Warchavchik (1927) in the *Domus* magazine, Gio Ponti pointed out that the "forms of rational architecture [...] demonstrate their great quality of adaptation to hot countries and fit neatly into the tropical vegetation" (PONTI 1933). He points out to the contrast between figure (house) and background (garden), which can be identified in the photos but not confirmed in space, where the continuity between architecture and vegetation was intended. The following houses by Warchavchik, from the Max Graf house (1928-1929) to the modernist houses of Itápolis Street (1929-1930) and Bahia Street (1930), show the search for interior-exterior continuity, made possible by the hot climate in the tropics. It was Bernard Rudofsky who associated the frank interior-exterior continuity with the typology of patio houses, common in Mediterranean architecture. His house in Procida, southern Italy, was designed as a manifesto of a healthy, solar and sensual life in the article "Non ci vuole un nuovo modo di costruire, ci vuole un nuovo modo di vivere"[2] (RODOFSKY, 1938). Having immigrated to Brazil because of the racial laws adopted by the fascist regime in 1938, Rudofsky designed the Frontini and Arnstein houses, which applied this proposal of open spaces for the gardens, adapted to the environment and tropical vegetation.

The advance in the creation of spaces that integrated the gardens to the interior of the houses had two important contributions in the following decade: Rino Levi, Italo-Brazilian schooled in Rome in 1926, and Daniele Calabi, Italian of Hebrew origin who took refuge in Brazil between 1939 and 1949. Levi built his first house in which the room extends to the garden in 1944, although without using the typology of patio houses. The garden consisted of specimens brought by Levi from exploratory journeys made with his friend, the landscape architect Roberto Burle Marx. But, unlike the pictorial gardens of the latter, Levi produced a set with the character of a forest, which invaded the room with its colors, textures and odors. The integration between interior and exterior was made by sensory experience.

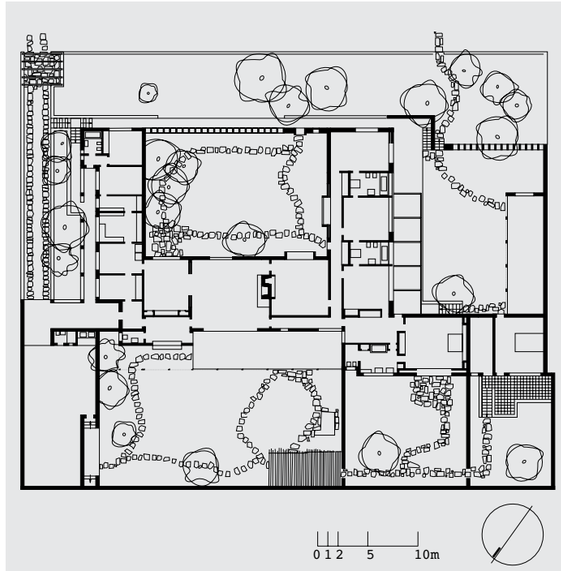


Figure 1
House Arnstein, plan of ground floor, São Paulo, 1940, Bernard Rudofsky architect.

Figure 2.
Interior garden of Castor Delgado Perez's house, architect Rino Levi, São Paulo, 1959. Photo: RA.

Figure 3.
Photo of the Casa de Vidro in 1952, without curtains, with garden with seedlings planted and arrangements of stones near the pilotis. Source: IB. Photo:Peter Scheier

More faithful to the classical parameters, Calabi built his own house using the typology of the patio house in 1945, taking advantage of the posterior slope to the Pacaembu valley to open a porticoed porch face. While living in this house after Calabi returned to Italy, Lina designed the Casa de Vidro.

The Bardi's house sets a new benchmark for this relationship. The transparent room is configured as a platform in reinforced concrete and glass panels, on cylindrical steel pillars, and that opens onto the landscape. Contrary to what is suggested today by the dense forest in which the house is located, it was not an existing forest, but a piece of land that had only a few concentrations of vegetation. The current dense tree garden is therefore an intentional construction, like the house, and not a natural pre-existence, and has been planted and cared for by the architect since the beginning of the work.

The floor-to-ceiling opening made by the movement of glazed frames draws back the glass mediation, which is already minimal for its transparency, and allows complete integration with the surrounding forest vegetation.

Art and nature: between the sublime and the metaphysics

Lina defined her house as a manifesto built in the effort to position herself in the midst of the debate on modern Brazilian architecture. The construction echoed her criticisms of what she identified as excessive formalisms of the new architecture – among them, the excessive use of *brises-soleils*, to which she expressed her disapproval in an article published during the design phase of the house (BARDI, Lina, 1951). Without sun protection, not even curtains (at least in the first year), and without parapets in the floor-to-ceiling window openings, the house deliberately exposes its occupant to the physical environment.

"The idea was to have a house that sheltered physically from wind and rain, but participating in poetry and ethics, which can be found even in the storm" (BARDI, 1953). The notion of the storm as a spectacle offered to the residents, who would be solemnly seated on the chairs with brass-ball in their arms, is clearly a reference to Kant and his "description of a furious storm," which illustrates the feeling of the sublime (KANT, 1764).[3] The vertigo arising from the edges of the raised slab, without any guardrail, corroborates this interpretation. Art and, in this case, architecture, which causes

Figure 4.
Armchairs with brass balls on their arms, design by Lina Bo Bardi, 1951. Source: IB. Photo: Peter Scheier.

Figure 5.
Engraving *Quarto do arquiteto* [The architect's room], Lina Bo Bardi, 1943. Source: IB.

astonishment and intensity, are the opposite that counteracts the soft fruition of the beautiful. The tranquility of the man designed by Le Corbusier, sitting in an armchair at the Ministry of Education and Health, contemplating the landscape of the hills of Rio de Janeiro, is opposed to the intensity intended by Lina in her dizzying plunge into tropical nature.

Some balance to interpose this telluric nature would be obtained by arranging the works of art and design within the transparent room. In addition to the friendship of the Bardi couple with the painter De Chirico (already mentioned in the previous texts), the mosaic at the top of the entrance staircase of the Casa de Vidro [4] confirms the harmony with his aesthetics. Although this relation is noted by several authors, the meaning of the metaphysical art for the Bardi is little explored. Oliveira (1997) compares Lina's *Quarto do arquiteto* [The architect's room] (1943) with De Chirico's *The Archaeologists* (1927), understanding that, while the latter places his objects in the past in a contemplative way, the architect brings them to the present, as instruments of action. Zollinger (2007) interprets it in another way, comparing Lina's work with surrealist collages, insofar as the association between the represented objects is entirely free, whereas De

Chirico is governed by the reconstruction of a hierarchy of the past. In a third interpretation, Corato (2012, p.186) proposes that, for architecture, the "atmosphere of alienation of objects and emptiness around them", present in metaphysical painting, would be an interpretation of the "forms and atmosphere of Italian cities."

The first lay-outs of the Casa de Vidro living room are strategies to create an atmosphere that conditions the enjoyment of the work of art. However, transparency for the surrounding tropical vegetation replaces the metaphysical scenarios inspired by the Italian cities, constituting the architect's first consistent confrontation with the country. The tranquility and balance of the paintings of De Chirico begin to be replaced by the vertigo of diving into nature.

Lina posing, looking at the nature around her, refers to the sublime, especially to the painting by Caspar David Friedrich,[5] where the European traveler contemplates the immensity of the mountain tops in a sea of clouds – here, the still green slopes in the outskirts of São Paulo.

Building the garden: from terror to love for the tropical nature

The photos of the Casa de Vidro of this time also show the seedlings planted in front of the house, in an effort to cover the slopes. Arrangements of stones, carefully laid out around the house, try to confer some aesthetic quality to outer space. The curve of the access ramp of the cars and the small reflecting pool, the "*Vasca*", under the drop line of the pluvial water drain pipes, full of aquatic species, complete the first landscaping at the time of the occupation of the house. The living in the metaphysical house was still at its beginning, without registering the marks of the profound transformations through which its inhabitants would pass in the following years.

As the couple lives in their home, which was very inhospitable in its early years, the first adjustments, such as the curtains, which had not been originally planned, appear. The lack of infrastructure in the neighborhood lasts for years, as can be noted with the incinerator, which attempts to compensate for the absence of public garbage collection. The telephone was only installed in 1956, a reason for celebration in a letter to Pietro, when she also gives account of her work in the garden with an assistant named Arnaldo and accompanied by her dog Victor.[6]

Figure 6.
Lina Bo Bardi in the living room of the Casa de Vidro. Source: IB. Photo: Chico Albuquerque.

Figure 7.
Enrico Galassi's mosaic, from Giorgio De Chirico's drawing, located at the top of the entrance ladder of the Casa de Vidro. Photo: Chico Albuquerque.

The approach to tropical nature occurs in trips to regions of Atlantic forest, such as the beaches in Caraguatatuba and Ubatuba, on the coast of São Paulo. The first trips were made with Roberto Sambonet and recorded by the artist in the paintings of the *Massaguaçu* show exhibited at the Masp in 1949 (CORATO, 2012, p.35-46). She met Burle Marx on the occasion of the 1950's Masp exhibition (BARDI, 1951), but remained eager to construct her identity with some independence. Her choice could not follow the same line as of Burle Marx's pictorial landscaping, although she accompanied her husband in acknowledging the importance of the Brazilian landscape artist.

The theme of nature and landscape has a strong presence in the article she writes for Bruno Zevi's magazine in 1956:

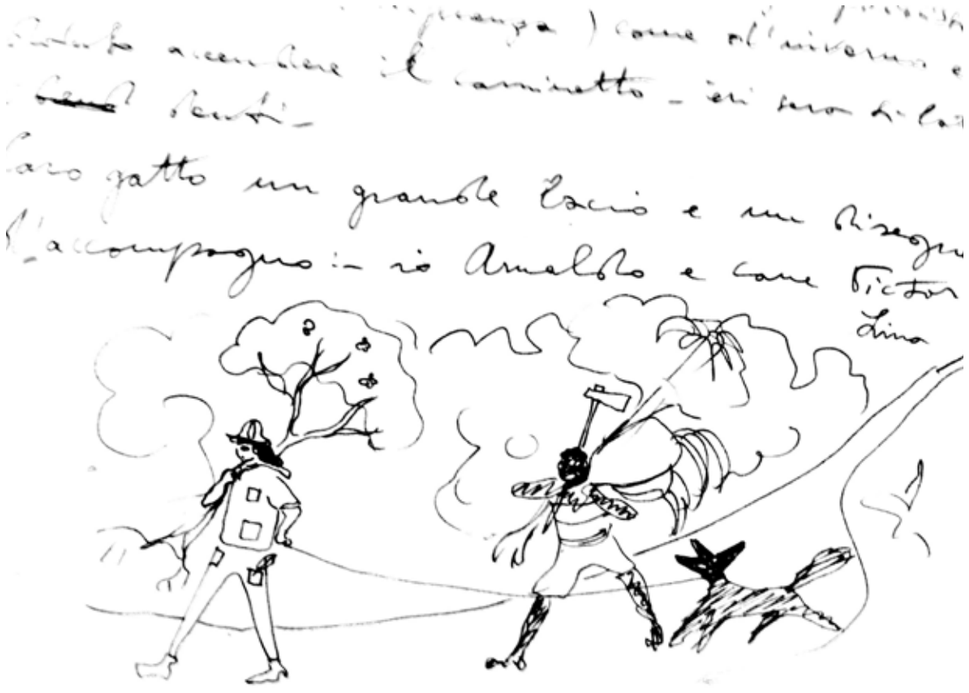
> Like a special envoy, I tried to pass an idea of this city by the ocean, whose cross-roads to the coast end against the forest full of "quaresmeiras" [Tibouchina granulosa] and violet and yellow acacia, philodendrons and bromeliads and all the plants that in Europe are only in flower shop windows.
>
> [...] The old terror against the forest is replaced by a more serene view, and where the forest was not destroyed to give way to plantations, terror turned into love. (BARDI, 1956)

The initial sublime sentiment, where the intensity stems from "danger" and "terror", is expressed by the fascination developed from real intimacy with the surrounding nature, flora and fauna, expressed in the letters to Pietro. The day-to-day report, the difficulties with plagues, the satisfaction of planting with her own hands, the flowering of orchids, the beauty of the sweet potato foliage.

The fascination makes her want a "natural architecture". The interlocution with Bruno Zevi, through frequent correspondence, made it clear that the "unnatural architecture" of the Casa de Vidro would not be repeated.

Figure 8.
View of the landscape from the pilotis of the Casa de Vidro. “Vasca” with aquatic plants in the reflecting pool and plateau on the car access ramp. Source: IB. Photo: Chico Albuquerque.

Figure 9.
Drawing by Lina Bo Bardi in a letter to Pietro Bardi, 1956. Source: IB.



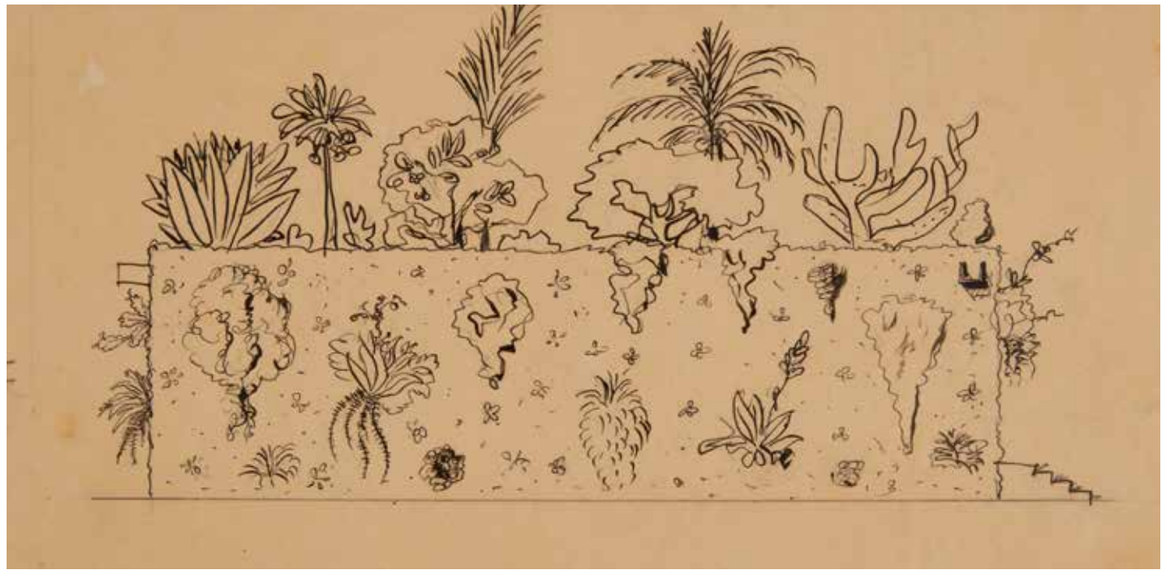


Figure 10.
Record of visit made by Lina Bo Bardi to the Park Güell, work of the architect Antoni Gaudí in Barcelona (1900-1914). Source: IB. Photo: PMB.

Organicism: architecture that mimics nature

In October, 1956, when returning from a trip to Italy, where she went to meet Pietro, Lina visits the work of Gaudí in Barcelona. Photographs of the Park Güell register the coverings and the organic forms that are mixed to the ground. The interest in the work of the Catalan artist, which had arisen through Bruno Zevi (1950), becomes a turning point in her own work, which then becomes orientated by organicism.

Lina continues to travel through Brazil, with expeditions, in 1958, to the countryside of Paraná, where, accompanied by Luiz Hossaka, she visits the rock formations of Vila Velha Park. In the Northeast region of the country, she visits the rock formations of Sete Cidades, in Piauí, photographing the erosions caused by the wind in the rocks.

Between 1957 and 1958, the first moments of the inflection of organicism, not only in the landscape made as of seeds “scatteredly thrown in the wind,”[7] but also in the construction of paths and small retaining walls that dialogue with the Gaudí’s architecture and with the surfaces of eroded rocks. The sinuosity of its trace allows the paths to have smooth slopes, while the necessary retaining walls have a low height. They are mostly brick walls on simple foundations, lined with rolled pebbles, with details on shards of sandstone slabs and ceramic shards to form delicate decorative themes. The discontinuous floor, with irregular slabs of sandstone, widens in some places, like small standing spots in the middle of the garden.

Lina also builds the new garage, which replaces the previous one. The volume is a regular parallelepiped that repeats the covering of the external walls to contrast with the white walls of the Casa de Vidro. The garden roof and the draining pipes, also covered with rolled pebbles, inaugurate a project line that would be applied soon after in the houses of Valeria Cirell in Morumbi and of the Chame-Chame in Salvador.

Figure 11.
Sketches for the Valeria Cirell's house, architect Lina Bo Bardi, 1958. Source: IB.

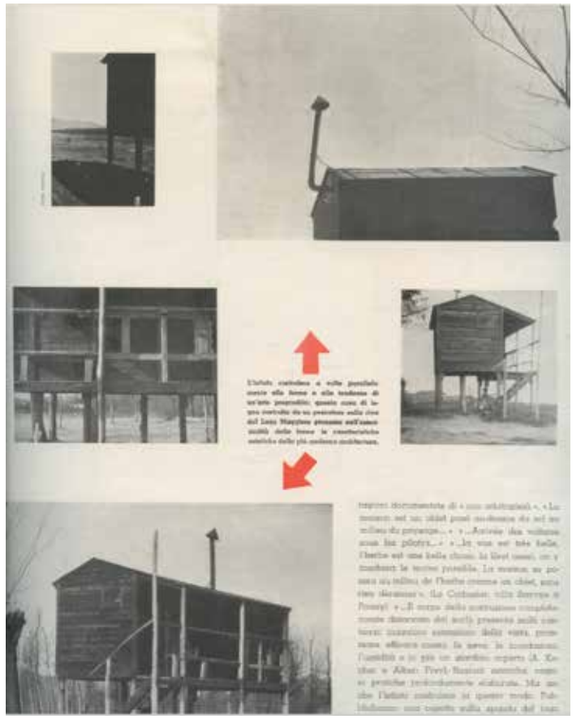


Figure 12.
Pictures of fishermen's houses on Lake Maggiore, Italy. Source: "Case sui trampoli", *Domus*, Milan, #194, p.272-4, Feb. 1944

Its architecture is transformed towards a "natural architecture". Among the projects that she develops in the following years, the new headquarters of the Masp is the one that would express the still uncertain steps of this transformation.

The project was elaborated between 1957 and 1960, initially without the glass facades, which only emerged at the end of 1965 (LIMA, 2013, p.126-9). Until the adoption of fully transparent facades, the museum as a whole moved away from the architecture of the Casa de Vidro and the Museum of São Vicente. The high volume, illuminated zenitally on the upper floor of the gallery's hall, would have opaque facades and, on the lower floor, a long horizontal window.

In a letter to Bruno Zevi dated June 1st, 1965, Lina describes the project and defends her positions for the Italian:

> A smooth volume that I will make full of tropical plants between the interstices of the rough concrete, like between stones of an old cathedral. Every time I go to the flowerbed, I remember your criticism of elemental volumes, the controversy of shoe boxes. Gaudí said that *the plan does not exist in nature* and therefore he, who believed in God, did not either. But the sublime is that man *make the plan that does not exist in nature*, with all the courage and melancholy of things "that man does alone", with no one's help.[8]
>
> Had it been built according to the original design, Masp would be an organic and opaque version of the Casa de Vidro and the Museu à Beira do Oceano [Museum on the Waterfront], with its rock-like concrete facades interspersed with tropical plants.

Figure 13.
Working desk of Pietro Maria Bardi in the room of the Casa de Vidro. Source: IB.

Popular culture and nature

The last intervention in the area of the Casa de Vidro was the construction of Lina's studio in 1986. The need for a space to support the development of the projects was due to the consolidation of the collaboration with young architects who supported her since Sesc Pompeia and the church in Uberlândia.[§] Implemented near the street, which allowed easy access for the staff and suppliers, the studio became known as "the little house", because it was built with popular techniques. Structure of trunks and planks of wood, two-ply cover of unshod ceramic tiles, wooden slabs of sliding panels painted in green and mosquito netting create a small volume that touches the ground to allow access, moving away from it according to the terrain falls toward the street.

The analogies with the Casa de Vidro itself are clear, accentuated by the absence of protection parapets on the windows, in the floor-to-ceiling opening of the sliding panels. But the constructive systems adopted are those of constructions without architects, of the popular culture deeply studied by the architect.

Surrounded by trees and bamboo, the "little house" affirms the analogy between the modern forms and the vernacular constructions defended in the article "Case sui Trampoli" [Stilt houses] in the pages of *Domus* in 1944, which can be attributed to it.

> Instinct sometimes builds parallel to the forms and tendencies of a progressed art; this wooden house built by a fisherman on the shores of Lake Maggiore presents, in the essentiality of its forms, the aesthetic characteristics of the most modern architecture. (DOMUS, 1944, p.272-4)

On the grounds of the house we find the records of both sorts of art, that of popular instinct and that one advanced. The house, its annexes and garden offer a description of the intellectual transformations of the architect. Annotations of a life in search of the essentiality, found in her plunge into the Brazilian popular culture and nature.

The uncontrolled growth of trees, which continued after the couple's death in the 1990s, created an unusual situation. The "unnatural" house, which observes nature, has lost its prospects for the landscape, which in turn has become a city of vertical buildings, mansions and favelas. The density of the woods enveloped the house in an enclosed environment for the urban landscape, protecting it from its aggressiveness. The proximity between the trees and the glazed room platform established a condition of tactile vision, as opposed to the original distance vision, thus altering the conditions of its aesthetic enjoyment. The set of buildings of house/annexes/garden acquires a symbiosis that suggests new directions for the relationship between architecture and nature. Post-mortem unfolding of the author's work becomes a contribution to contemporary culture, made possible by the preservation of its whole and by its availability for public visitation.

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Notes

1 This article develops the arguments of ANELLI, Renato L. S. "Casa de Vidro: architecture, art and nature". In: SANCHEZ, Mara Llorens; FONTÁN, Manuel del Junco; TOLEDO, Maria Gutiérrez (Orgs.). *Lina Bo Bardi. Tupi or not tupí. Brasil, 1946-1992*. Madrid: Fundación Juan March, 2018, v.1, p.60-71. The topic "Mediterrâneo nos trópicos" [Mediterranean in the tropics] summarizes the main arguments of the chapter with the same name as ANELLI, R. L. S .; GUERRA, A .; KON, N. *Rino Levi, arquitetura e cidade*. São Paulo: Romano Guerra Editora, 2001, p.89-101.

2 "We do not need a new way of building, we need a new way of living".

3 The first identification of the sublime in Lina Bo Bardi's work was suggested by Campello (1998) in his master's thesis.

4 The mosaic was made by the Italian artist Enrico Galassi from a drawing by De Chirico given to the couple as a gift.

5 Painting *Der Wanderer* über *dem Nebelmeer* (1818), by Caspar David Friedrich. Collection of the Kunsthalle Hamburg.

6 Pietro spent the year of 1956 in Italy preparing the book *The Arts in Brazil – A new museum at São Paulo*, Edizioni de Il Milione, Typografia Esperia (Milan, 1956), and a catalog for the Kress Foundation. Lina's letters to him are part of the Bardi Institute collection and are being organized by Anna Carboncini.

7 Letter to Bardi, op. cit.

8 Letter from Lina Bo Bardi to Bruno Zevi dated september 1st, 1965. Bardi Institute Collection. [The highlights are ours.]

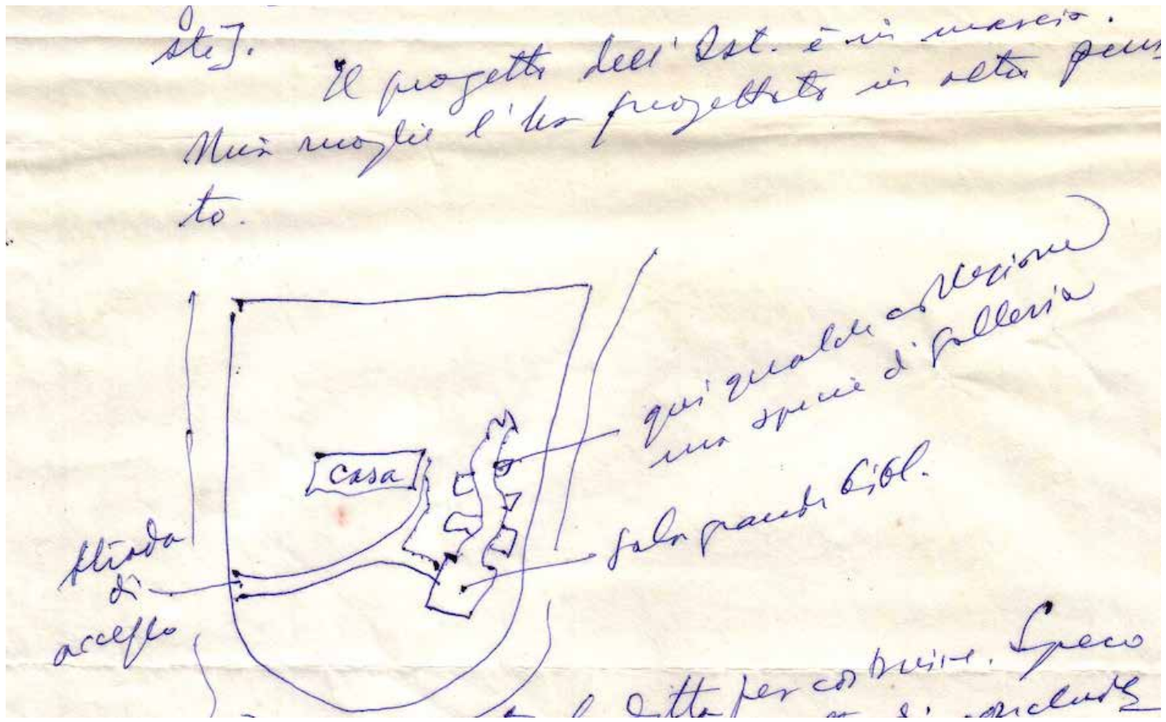
9 Marcelo Ferraz and André Vainer collaborated with Lina since 1976; Marcelo Suzuki started his collaboration in 1980.

2.5 The Instituto Bardi and the Casa de Vidro

Ana Lucia Ceravolo
Renato Anelli

Figure 1.
Sketch indicating the location and shape of a new building for the art collection and library, attached to the Glass House, site of the current studio. Pietro Maria Bardi in letter to Ettore Camesasca, February 2nd 1976. Source: Archivio Ettore Camesasca, Milano.

Figure 2.
Study of a building occupying the pilotis of Casa de Vidro Lina Bo Bardi, no date. Source: IB



Landmarking

The conservation of the Casa de Vidro [Glass House] imposes upon us an understanding of the space that the Institute occupies within it, being that both constitute the legacy of the Bardis equally. The preservation of the Casa de Vidro is associated with the creation of a cultural institution, as attested to by the justifications expressed by the Bardis in the initiation of the landmarking process with the Council for the Defense of Historical, Archaeological, Artistic and Touristic Heritage – Condephaat, the agency responsible for public preservation policies in the state of São Paulo. In a letter to the Council's president, Modesto Carvalhosa, dated June 23, 1986, Lina Bo Bardi writes:

> I am sending the documentation of our house in Morumby: the deed, blueprints and photos of the house, my curriculum. (...). I would like it very much for the house to be landmarked: and by you, Sir. And in terms of the foundation, I thought more about the Mindlin foundation (...). Also enclosed here is a letter from Pietro, written a few days ago. (CONDEPHAAT, 1986, pp. 1-2)

Bardi's letter, (dated October 25, 1985), also addressed to Modesto Carvalhosa, is even more detail-oriented and emphatic in terms of how the house and the foundation should function:

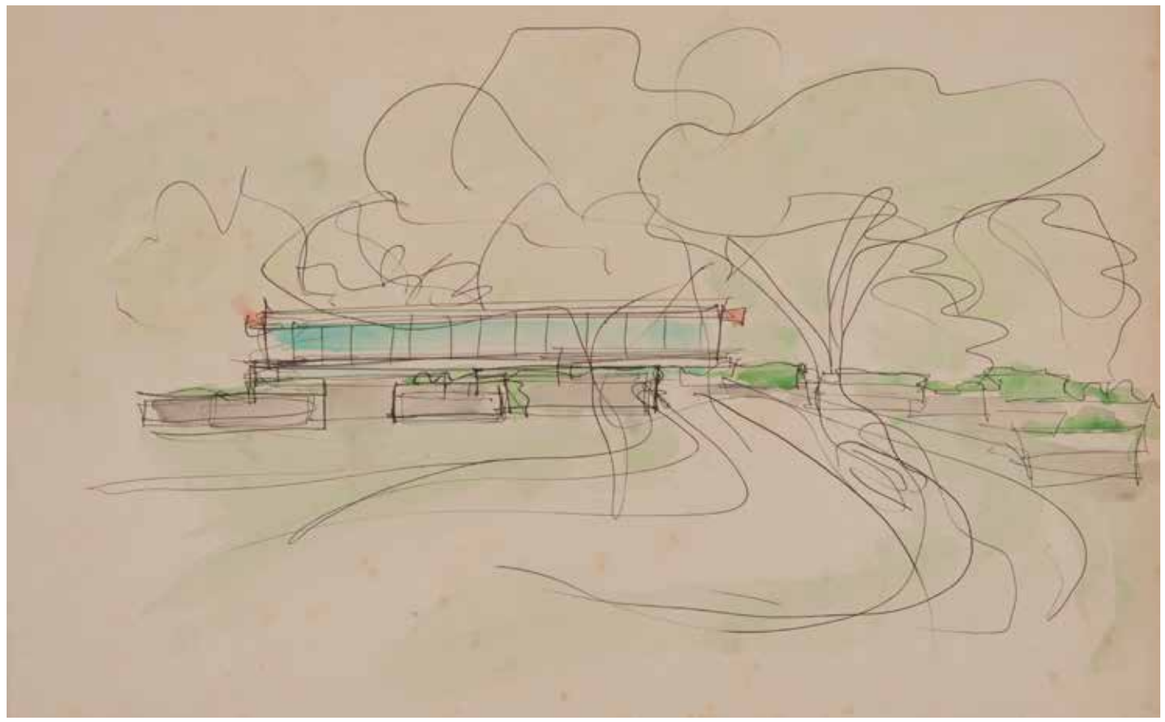
> (...) Allow me to complement my wife Lina's idea in terms of the possibility of designating our house and art objects for a foundation capable of transforming it into a curious example of a dwelling of immigrants, who contributed to the promotion of the arts in Brazil in the sectors of architecture (the habitation of Morumby, the MASP building on Avenida Paulista, the restoration of the Pompéia Factory, the restoration of the Politeama Theater in Jundiaí), the museographical sector (creation of MASP and notable donations), in the field of journalism (the magazine 'Habitat,' 'Mirante das Artes,' 'Vogue Arte') and publishing (an ample bibliography).
>
> I think that the Morumby House, once restored at our expense, with its forest-garden, could be adapted with a series of works of art of a certain value, to one day be visited by a public interested in experiencing a portion of the history of the renovation of national museography. (...)
>
> In practical terms: the Foundation's responsibility will be the conservation, custodianship of a collection of works of art (…) The entire project should be studied by a representative of the foundation and the undersigned.

Bardi envisages the creation of an institution, which he denominates as foundation, that should preserve the house, their collection and the way of exhibiting it, presenting it to the public in the future.

Ever since the years he lived in Italy, Bardi's career was driven by the administration of magazines and cultural institutions focused on the formation of artists. The Museum of Art of São Paulo (MASP) was the most successful of them all. Though its origins can be traced back to the plan to build a headquarters for the Institute of Contemporary Art on land acquired by MASP in the vicinity of the house, this institution had a much different objective. The foundation cited in the landmarking process was to be central for the survival of the Bardis' legacy beyond their old age and death. The preservation of the house, garden, the works of art and their museography provide continuity to the educational activities in which they were engaged throughout their lives. The Casa de Vidro, expanded with the installations of this institution, will be the last museum of their creation, dedicated to their own intellectual history, created and directed by them in the few years leading up to their deaths. A museum aligned with those they created and administered in life-- in other words, active in the formation of artists and the art-viewing public.

In the final opinion, authored by architect Marco Antonio Tabet[1], the singularities of the Casa de Vidro's architecture are highlighted, with a rationale that compares it to residences in São Paulo, alongside arguments that highlight the Bardis' contributions to modern culture. It ends by positing the need for a more careful study of the collection, also justifying its preservation.

The decision to landmark, which came on September 1, 1986, mentions the need for a future building to house the institution proposed by the Bardis, explicitly stating that the decision to landmark was approved unanimously, "(...) also foreseeing the construction of an area for the library and auditorium.[2]"



On different occasions, both Lina and Pietro created sketches for the project. Years before the landmarking, in a letter written to Ettore Camesasca in 1976, he presents his friend in Italy with a sketch of its possible implantation on the Casa de Vidro's land. The drawing resembles Lina's studies for an addition below and to the side of the house, with no identification or date in the collection, published by Oliveira (2006) as "studies for the expansion of the Casa de Vidro" realized in the 1970s, proposing a pavilion at the foot of the residence, in the area beneath the pilotis.

Lina and Pietro Bardi's sketches for the project for the Institute's headquarters on the Casa de Vidro's land present great freedom in the formal conception and occupation of the area full of trees. Nonetheless, in subsequent years, the only construction realized was the studio, a formally contained project, where the structure and the wood walls are covered by a discreet roof of ceramic mission tiles.

Figure 3.
Casa de Vidro adaptation proposal to the venue of an institute or foundation, Lina Bo Bardi at the opening of the landmarking process. Project made with the collaboration of Marcelo Suzuki, 1986. Source: Casa de Vidro Landmarking Process at CONDEPHAAT.

The Institute

The current Bardi Institute was founded on May 3, 1990, initially denominated as the Quadrante Institute, a reference to the Italian magazine run by Bardi and Massimo Bontempelli (1933-1936). Its founding members were Pietro Maria Bardi (president) and Lina Bo Bardi (vice-president), who constituted the institution's executive board, and six members, comprising the Board of Trustees: Mrs. Graziella Bo Valentinetti, Lina's sister, who stayed on at the institute until her death in 2008, the painter, illustrator and museologist Fábio Luiz Pereira de Magalhães, the lawyer and professor at the University of São Paulo Law School Modesto Carvalhosa, the lawyer, businessman, writer and bibliophile José Ephim Mindlin, the lawyer and director of SESC Renato Antônio Quadros de Souza Requixa and the lawyer who had been part-owner of the art gallery Mirante das Artes alonside Pietro Maria Bardi and one of the most renowned art dealers and art connoisseurs of the day, Renato Magalhães Gouvêa. The institution's area of operations and mission were defined in the official record of its founding:

The objectives of the INSTITUTE [*sic*] are exclusively cultural and artistic, and also related to the history of art and architecture, capable both of promoting and practicing any activity and inherent to their ends[3].

For these objectives, the Bardis provided the institution with funds they acquired by selling the painting *Portrait of Don Sebastien Marie Gabriel de Bourbon and Braganza* (1820) by Spanish artist Francisco Goya, which had been part of the Bardis' collection since 1955. The amount obtained from the sale was US$3.6 million and constituted the endowment utilized to preserve the Casa de Vidro, its collection of art and architecture, as well as to provide support for its mission.

It is important to emphasize that the first statute established that, in the event of the Institute's dissolution, the house, along with the entire collections and works, should be donated to the Museum of Art of São Paulo – MASP, demonstrating their trust and proximity regarding the institution they helped create and consolidate.

Between 1990 and 1991, shortly after its creation, the Institute dedicated itself to establishing a line of operations focused on financially supporting cultural projects. In addition to supporting other institutions, the institute defined its editorial line.

In 1995, Bardi, already quite ill and no longer working at MASP, transferred the right of ownership of the Casa de Vidro back to the Institute by way of a deed of donation[4].

The donation established that the Institute should assume extra burdens in return. The first was to authorize that Bardi and his sister-in-law, Graziella Bo Valentineti, continue living in the house for the remainder of his life, receiving a monthly sum of R$10,000, designated for the property's maintenance and the residents' healthcare expenses. The deed of donation also established that, after Bardi's death, his sister-in-law should move out of the house in 120 days, with the Institute continuing to pay her the same sum, corrected monthly, for the remainder of her life. It further determines that she should be elected president of the Institute at the first assembly following Bardi's death.

With no residents, the house would become "the 'headquarters' of the recipient Institute, with its residential characteristics maintained according to the wishes of Archillina Bo Bardi."

The Institute was given its new denomination, the Lina Bo and P.M. Bardi Institute in 1993, the year after Lina's death, connecting it "definitively to the names of their benefactors."[5] With Lina's death, thus began a period in which she became the center of the Institute's activities. In her former office, the "casinha" [literally "little house"], a staff directed by Marcelo Ferraz and the architect's past collaborators kept the Institute active, initiating the first systemization of the Bardis' collection. It was there, in the space where they developed their projects, that the MASP exhibition was organized, opening at the museum in 1993 accompanied by the complete catalog of their work (FERRAZ, 1993) and the documentary directed by Aurélio Michilles and Isa Grinspum Ferraz.

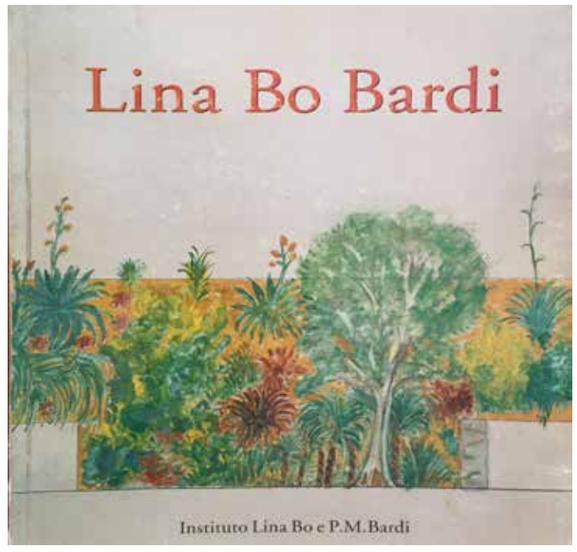


Figure 4.
Lina Bo Bardi, book organized by the Instituto Lina Bo e P.M. Bardi (Marcelo Ferraz) to be the catalog of the exhibition of the architect's work in 1993, at Masp.

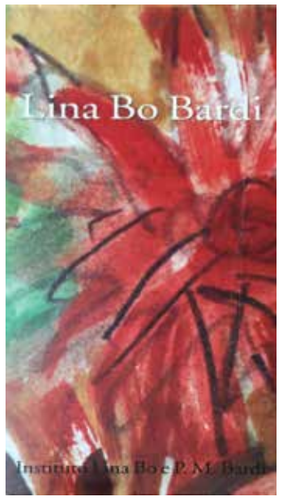


Figure 5.
Video documentary Lina Bo Bardi, directed by Aurélio Michilis and Isa Grinspum Ferraz, 1993.

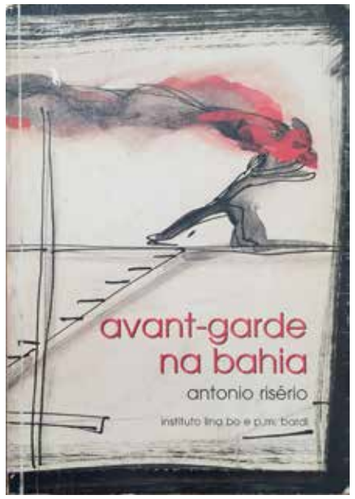
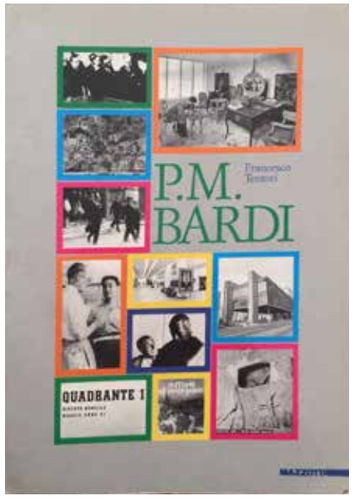


Figure 7.
Avant-garde na Bahia book, by Antonio Risério, Instituto Lina Bo and P. M. Bardi edition, 1995.



igure 9.
Biography of Pietro Maria Bardi, by Francesco Tentori, published in 1990 in Milan by the Mazzota editor. The Instituto Lina Bo e P. M. Bardi published the Portuguese version in 2000.

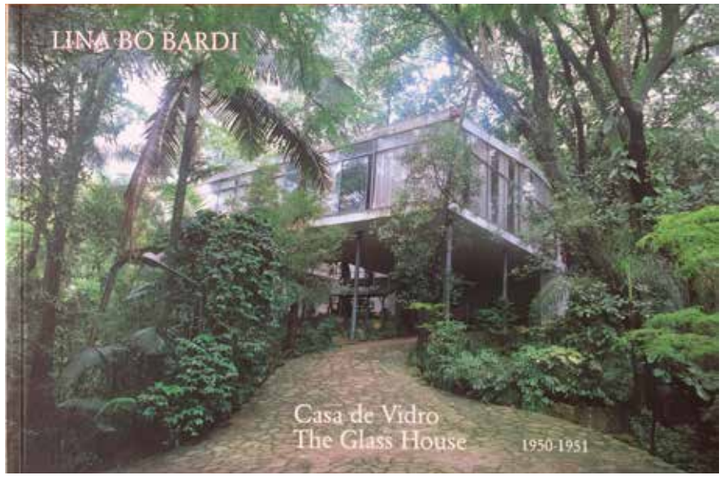
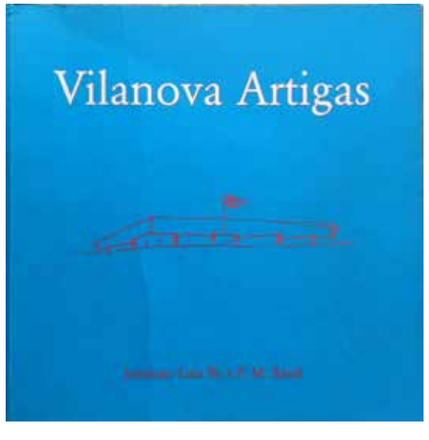


Figure 8.
Casa de Vidro book, published by Instituto Lina Bo e P. M. Bardi in collaboration with the Editorial Blau, Lisbon.

Figure 6.
Vilanova Artigas Book, organized by the Instituto Lina Bo e P.M. Bardi in collaboration with the Vilanova Artigas Foundation, 1997.



The success of this ensemble of Lina Bo Bardi's work in Brazil fueled its itinerancy around the world. Translated into English and Italian, the catalog and versions of the exhibition are circulated in several countries. The initiative represented a thorough promotion of her work around the world to a public previously unaware of her existence and thus conferring upon her international recognition. Various aspects of her career, accentuated by the way it was interpreted in the narrative assembled by the exhibition, catalog and video, were very well received in Brazil and abroad: the attention to the popular without contrasting with the modern, at a moment of post-modern burnout, the politically combative character, the transiting between multiple art forms – cinema, theater, the visual arts, applied art and, not the least important of which, the female gender at a moment when men still dominated the field of architecture. It should be noted that one involuntary result of Lina Bo Bardi's success was the subsequent overshadowing of her husband. A biography of Bardi, written by Francesco Tentori in 1990 and formerly only available in Italy, was published in Portuguese in 2000.

In this way, the editorial line of the Bardi Institute was granted continuity, focusing on promoting studies of the work of Brazilian architects with relevant careers, but who had yet to have their architectural work circulated in the form of books with high graphic production value and iconographic information on their projects. Through these books, the work of Lina Bo Bardi, Afonso Eduardo Reidy, Vilanova Artigas and João Filgueiras Lima (Lelé) have gone on to inform new generations of architects, able to learn to design by studying the project drawings and photos of the works. The publications thus attend the Bardi Institute's mission of acting "with the history of art and architecture," making an important contribution to the new history of Brazilian architecture and establishing a new editorial standard in the area.

Pietro Maria Bardi died in 1999, resulting in major alterations in the institution's operations. Up until then, he had occupied the presidency, in spite of his advanced age, and the vice-presidency was held by Graziela Bo Valentinetti, who took the position in 1992 after Lina's death. As specified in the deed of endowment of the Casa de Vidro to the Institute, with Bardi's passing, Graziela assumed the presidency. Shortly after, Marcelo Ferraz and his team departed from the Institute' administration, closing a period of the Institute's history marked by the continuance of the founding couple's activities and plans.

Also in the wake of Bardi's passing came claims to his estate from heirs from his first marriage who reside in Italy. As a result of the division of assets, the Casa de Vidro lost some of its most valuable pieces of furniture and works of art, irreversibly disfiguring the internal assembly of the living room. Nonetheless, the division preserved the ownership of the Casa de Vidro and the vast majority of its collection in the hands of the Institute.

Figure 10.
Jotabê Medeiros article "Stagnant institution, tradition of the city", O Estado de São Paulo newspaper, March 21st, 2007.


Instituição estagnada, tradição da cidade

Instituto Lina Bo, Galeria Prestes Maia, Museu do Folclore: que futuro eles têm?

SÉRGIO CASTRO/AE - 12/6/200

Jotabê Medeiros

Instituições culturais estagnadas não são novidade em São Paulo. Algumas delas já tiveram vida ativa e grande movimento, mas hoje estão fechadas ou em compasso de espera. É o caso do Instituto Lina Bo e P.M. Bardi, no Morumbi. Criado por Pietro Maria Bardi, abriga a Casa de Vidro, projeto da arquiteta Lina Bo Bardi (1914-1992) tombado pelo Iphan no dia 9 de dezembro como patrimônio nacional.

A Casa de Vidro, erguida em 1951, é uma edificação modernista comparada à famosa Casa da Cascata de Frank Lloyd-Wright nos Estados Unidos, um marco arquitetônico. Após a morte de Bardi e Lina, disputas familiares truncaram seu desenvolvimento.

A última exposição realizada pelo instituto foi a mostra *Lina Bo Bardi Arquiteta*, inteiramente importada da Itália, onde fora montada originalmente. A administração buscou recursos de R$ 710 mil junto à Lei Rouanet para cobrir custos, mas não conseguiu patrocínio. Atualmente, a maior atração da instituição, a própria Casa de Vidro, não recebe visitantes. Desde 2 de outubro, estão suspensas as visitas para obras de revitalização, que prevêem descupinização do seu interior e das peças do acervo, além de reparos em pontos de infiltração nas lajes e paredes.

Curiosa situação também vigora na Galeria Prestes Maia, na Pra

CASA DE VIDRO – Descupinização

ça do Patriarca, hospedeira do Inc cógnito Masp-Centro. A reforma dos 6 mil m² da galeria já consu miu mais de R$ 6 milhões, mas sua vocação – a de se abrir para o centro de São Paulo – jamais se concretiza. A última proeza da administração foi vetar a passagem pelo seu interior dos visitantes da mostra *Anish Kapoor*, do CCBB, alegando insegurança.

No ano passado, o Museu da Imagem e do Som realizava um show do músico Matt Costa. Bloqueante no bairro, e descobriu-se que nem gerador tem a institui ção, que é do Estado. E o Museu do Folclore? 30 mil peças e 5 mil livros, alguns recolhidos por Má rio de Andrade, vagam por gal pões da Prefeitura, em busca de lugar ao sol. Na cultura da polí tica, prepondera a política sem da cultura. Ou a miopia.

The years under Graziela Bo Valentinetti's administration, from 1999 to 2008, were characterized by the Institute's difficulties in keeping up its former pace of operations. On March 21, 2007, the newspaper Estado de São Paulo published an article entitled "Institution stagnated, tradition of the city," reporting that visitation to the house had been suspended. Indeed, the building's conditions were precarious and the detachment of the lining on the underside of the slab above the entrance compromised the safety of visitors. And the end of the funds from the endowment were already within view, being that the revenue from financial support was insufficient to maintain the institution.

In 2006, the Institute counted on support from FIAT to bring the exhibition "Lina Bo Bardi Architect" to MASP, curated by Italian professors from Iuav University in Venice and originally presented at the 2004 Venice Biennale (GALO, 2004). The exhibition drew approximately 83,000 visitors. But the Bardi Institute would not enjoy the same success in its requests to obtain further support, not for the maintenance of the buildings, nor for the organization of the collection.

All the same, the Institute initiated the most pressing maintenance operations using its own funds. The operations were directed by Marcelo Suzuki, a former collaborator of Lina Bo Bardi's and the architect responsible for the 1993 maintenance project. The termite control efforts, initiated in 2007 under the guidance of technicians from the Institute of Technological Studies (Ipt), were followed by maintenance on the finishings and casements, hydraulic installations and roofs, interventions that would last until 2009[6].

After the president's death in 2008, Mr. Giuseppe D'Anna was chosen to replace her. For the first time, the Institute's presidency was held by someone who was not a relative of the Bardis. D'Anna's administration concentrated on institutional organization and the execution of projects to raise funds in support of culture and research.

Figure 11.
Lina Bo Bardi's room oxidation of the metal sheet casement, 2006. Source: IB. Photography: MCB

Figure 12.
South façade of the house, with damage to the exterior cladding and oxidation of the casement, 2006. Source: IB. Photography: MCB

Figure 13.
As a result of infiltrations and lack of proper maintenance, cracks, loosening of the plaster and paint on the underside of the upper slab, under the gutter, appeared. 2006. Source: IB. Photography: MCB

Figure 14.
Degradation of the kitchen casement by intense oxidation. 2006. Source: IB. Photography: MCB

Figure 15.
Restoration of the Vidrotil tile floor. 2007. Source: IB. Photography: MCB

Figure 16.
Changing of the particle wood, of the wall cupboard doors. 2007. Source: IB. Photography: MCB

Figure 17.
Anti-termite treatment of works of art and historical furniture. 2007. Source: IB. Photography: MCB

Financial sustainability and institutional arrangement

The period that began with the D'Anna administration was characterized by the challenge of the Bardi Institute's financial sustainability and the search for institutional arrangements appropriate for the institution's reality. The fund generated by the Bardis' sale of the Goya painting remained an anchor of stability for the Institute until it ran out in early 2014.

At the time, the institution managed to survive on funds raised from the commercialization of copyrights and projects in support of culture and research. The collection of architectural drawings, photos of projects under construction, films and other registers of Lina Bo Bardi's career were requested for publications and exhibitions, accompanying the progression of the architect's international prestige.

After the initial phase, sustained by its own resources, the collection was organized with support from grants from institutions like Caixa Econômica Federal, Petrobras and the State of São Paulo Research Support Foundation (Fapesp)[7].

This support allowed to the Institute to rise to a level of professionalism rarely seen in private architecture collections in Brazil, a factor that was fundamental in the collection's capability in providing support to exhibitions held in São Paulo, Munich, Rome, New York, Zurich and other world cities in commemoration of Lina Bo Bardi's 100th birthday in December of 2014.

A contract with the Italian furniture firm Arper to produce a limited series of Bardi Bowl chairs, released in January of 2014, ushered in the commercialization of the copyrights to the furniture that Lina designed, which extended into a contract with the Brazilian company Etel.

In 2014, Sonia Guarita do Amaral was elected president of the Bardi Institute. Her administration began with an agreement by Petrobras to provide financial support for the consolidation of the institution. A new institutional design began which in 2016 effected the transformation of the non-profit Cultural Association into to a Social Organization (SO) in the area of culture. To expand fundraising, the Society of Friends of the Bardi Institute was created, holding an auction of works of art in order to raise money necessary to maintain the organization.

The institution's new SO format is regulated in Brazil by Federal Law no. 9.637/1998, and in the State of São Paulo by Complementary Law no. 1.243/2014, and its purpose is to allow the Public Administration to appoint a non-profit association to realize actions in the area of culture with direct sponsorship from the public budget. Despite this possibility, the Institute was not successful in getting this sort of appointment, having thus far participated in only one competition promoted by the State Secretary of Culture to manage the Museum of the Brazilian Home in the second half of 2016.

The OS format altered the method of operations in effect. Up until 2016, the Institute was structured with a Presidency, Board of Directors, Council and Assembly of Associates. The presidency participated in the board of directors, which was composed of five members with no specific attributes, forming a sort of collegial management, in which each member assumed an executive responsibility. There were few meetings of the board and the assembly, held in accordance with the statute.

The SO is structured by a Board of Directors, Administrative Council, Supervisory Board and Assembly of Partners. It is now a more specialized organization than the previous one, with separation and hierarchy between the Administrative Council and the Board of Directors. The directors are chosen by the council, who are prohibited from serving on the board. Unlike in the non-profit association, the directors are allowed to receive salaries.

The political changes in the country in 2016 resulted in the interruption of support from Petrobras, once again putting the Institute in a situation of financial imbalance. To ensure its survival, a drastic reduction in personnel was made and a search began for new types of resources. The economic recession that followed made it very difficult to procure new financial support through cultural incentive projects.

The Institute survived this crisis thanks to four types of resources: admission tickets, the sale of books and souvenirs to visitors, the commercialization of the copyrights of Lina's furniture, images and payments for loaning works of art, location rental for photo shoots and social events related to culture, support and donations through cultural projects providing tax breaks, which essentially maintained the cultural activities promoted by the Institute.

Today, the Directors act in accordance with the work plan approved by the Board, to which they must report. The brief experiment in the SO format demonstrates overlaps in the positions of the Director President and Board President, which need to be better defined. The other directorial position is Technical. The current administration, which began in the first half of 2018, informally expanded the denomination of the Technical Directorship to Technical and Cultural Directorship, thus specifying its curatorial role. In turn, the task of fundraising is shared by both Directors as well as by members of the Administrative Council.

The Casa de Vidro as house-museum

The present moment is an opportune one for us to once again reflect on the character of the ensemble comprised of the Bardi Institute and the Casa de Vidro[8] and the best institutional design for preserving it. Since the beginning of Sonia Amaral's administration, the institution has moved closer to the museum typology of a historical house, according to the concept designed by the International Council of Museums – Historical Houses (DEMHIST/ICOM)[9]. The Management and Conservation Plan should be rooted in a reflection on whether this typology is coherent with Bardi's intention in "designating our house and art objects for a foundation capable of transforming it into a curious example of a dwelling of immigrants", bringing in visitors to learn the life and story of the husband and wife who contributed to promoting the arts in Brazil.

Lina and Pietro Bardi were pioneers of museology and museography in Brazil, in restoration and in the cultural projects they developed. By assuming a house-museum typology, the Bardi Institute is aligned with the Bardis' avant-garde posture, also considering their expectations regarding the institution's mission.

As the conservation of the Casa de Vidro presupposes a change in use and it is important to keep in mind that the theme of adjustment or adaptation of cultural assets to the incorporation of new functions often comes up in debates on preservation and restoration. As established by the Venice Letter, preservation presupposes use, as long as it is compatible with the property's characteristics.

> The conservation of the monuments is always favored by its designation as having a useful function for society. This designation is, however, desirable, but it cannot nor should it alter the disposition or decoration of the buildings. It is only within these limits that modifications required by the evolution of uses and customs should be conceived and authorized. (VENICE CHARTER, 1964, article 5)

The typology of a historical house-museum is the most pertinent alternative use to enable the Casa de Vidro to maintain its characteristics while also adequately receiving the Institute's installations, promoting visitation and culturally educational activities.

In a house-museum, as currently conceived of by DEMHIST/ICOM, the cultural asset is the actual building, collection and owner. These three points of reference are not disconnected and, as such, the relationships established between them favor communication, allow for greater interaction with the space visited and the possibility of perceiving the historical period and society embodied in it, establishing connections with the present in a critical manner.

An educational proposal that is committed to man in transformation, utilizing the diverse means at its disposal, but which have the objective of enabling the participant (Man/subject) to reflect in a critical and participative manner on the message received. And the best way for this is through wonderment, questioning, inquiry. And not answering (CABRAL, 1988).

House-museums provide a slice of reality, avoiding sweeping generalizations and offering a more intimate, subjective vision of history. They open up the possibility of more direct and less abstract relationship between the public and the museum, allowing for the creation of bolder projects.

The house is the space of shelter, of protection and the place from which personalities express their relationship with the world. The greatest heritage of a house-museum is the very professional activity of the individual whose memory we want to preserve. It is fundamental to create conditions so that their ideal is kept alive through correlative activities (DOCTORS, 2010).

This combination of ideas allows us to envisage a house-museum of two personalities central to the history of the arts and architecture in Brazil from the 1940s to the 1990s. With Lina's actions in mind, the Casa de Vidro should be a gateway to her work. With Bardi's contributions in mind, the Casa de Vidro is a possibility of experiencing a collection of a broad historical spectrum. Yet, it is also a connection to their greatest work: the Museum of Art of São Paulo.

The Casa de Vidro safeguards the memory of its patrons, but it is through the Institute that it becomes a living building that is active in the cultural construction of the present. As such, the Management and Conservation Plan structures policies, actions and goals that allow the Bardi Institute the possibility of achieving the objectives for which it was created and maintaining the assets in its custody.

The OS format altered the method of operations in effect. Up until 2016, the Institute was structured with a Presidency, Board of Directors, Council and Assembly of Associates. The presidency participated in the board of directors, which was composed of five members with no specific attributes, forming a sort of collegial management, in which each member assumed an executive responsibility. There were few meetings of the board and the assembly, held in accordance with the statute.

The SO is structured by a Board of Directors, Administrative Council, Supervisory Board and Assembly of Partners. It is now a more specialized organization than the previous one, with separation and hierarchy between the Administrative Council and the Board of Directors. The directors are chosen by the council, who are prohibited from serving on the board. Unlike in the non-profit association, the directors are allowed to receive salaries.

The political changes in the country in 2016 resulted in the interruption of support from Petrobras, once again putting the Institute in a situation of financial imbalance. To ensure its survival, a drastic reduction in personnel was made and a search began for new types of resources. The economic recession that followed made it very difficult to procure new financial support through cultural incentive projects.

The Institute survived this crisis thanks to four types of resources: admission tickets, the sale of books and souvenirs to visitors, the commercialization of the copyrights of Lina's furniture, images and payments for loaning works of art, location rental for photo shoots and social events, support and donations through cultural projects providing tax breaks, which essentially maintained the cultural activities promoted by the Institute.

Today, the Directors act in accordance with the work plan approved by the Board, to which they must report. The brief experiment in the SO format demonstrates overlaps in the positions of the Director President and Board President, which need to be better defined. The other directorial position is Technical. The current administration, which began in the first half of 2018, informally expanded the denomination of the Technical Directorship to Technical and Cultural Directorship, thus specifying its curatorial role. In turn, the task of fundraising is shared by both Directors as well as by members of the Administrative Council.

The Casa de Vidro as house-museum

The present moment is an opportune one for us to once again reflect on the character of the ensemble comprised of the Bardi Institute and the Casa de Vidro[8] and the best institutional design for preserving it. Since the beginning of Sonia Amaral's administration, the institution has moved closer to the museum typology of a historical house, according to the concept designed by the International Council of Museums – Historical Houses (DEMHIST/ICOM)[9]. The Management and Conservation Plan should be rooted in a reflection on whether this typology is coherent with Bardi's intention in "designating our house and art objects for a foundation capable of transforming it into a curious example of a dwelling of immigrants", bringing in visitors to learn the life and story of the husband and wife who contributed to promoting the arts in Brazil.

Lina and Pietro Bardi were pioneers of museology and museography in Brazil, in restoration and in the cultural projects they developed. By assuming a house-museum typology, the Bardi Institute is aligned with the Bardis' avant-garde posture, also considering their expectations regarding the institution's mission.

As the conservation of the Casa de Vidro presupposes a change in use and it is important to keep in mind that the theme of adjustment or adaptation of cultural assets to the incorporation of new functions often comes up in debates on preservation and restoration. As established by the Venice Letter, preservation presupposes use, as long as it is compatible with the property's characteristics.

> The conservation of the monuments is always favored by its designation as having a useful function for society. This designation is, however, desirable, but it cannot nor should it alter the disposition or decoration of the buildings. It is only within these limits that modifications required by the evolution of uses and customs should be conceived and authorized. (VENICE CHARTER, 1964, article 5)

The typology of a historical house-museum is the most pertinent alternative use to enable the Casa de Vidro to maintain its characteristics while also adequately receiving the Institute's installations, promoting visitation and culturally educational activities.

In a house-museum, as currently conceived of by DEMHIST/ICOM, the cultural asset is the actual building, collection and owner. These three points of reference are not disconnected and, as such, the relationships established between them favor communication, allow for greater interaction with the space visited and the possibility of perceiving the historical period and society embodied in it, establishing connections with the present in a critical manner.

An educational proposal that is committed to man in transformation, utilizing the diverse means at its disposal, but which have the objective of enabling the participant (Man/subject) to reflect in a critical and participative manner on the message received. And the best way for this is through wonderment, questioning, inquiry. And not answering (CABRAL, 1988).

House-museums provide a slice of reality, avoiding sweeping generalizations and offering a more intimate, subjective vision of history. They open up the possibility of more direct and less abstract relationship between the public and the museum, allowing for the creation of bolder projects.

The house is the space of shelter, of protection and the place from which personalities express their relationship with the world. The greatest heritage of a house-museum is the very professional activity of the individual whose memory we want to preserve. It is fundamental to create conditions so that their ideal is kept alive through correlative activities (DOCTORS, 2010).

This combination of ideas allows us to envisage a house-museum of two personalities central to the history of the arts and architecture in Brazil from the 1940s to the 1990s. With Lina's actions in mind, the Casa de Vidro should be a gateway to her work. With Bardi's contributions in mind, the Casa de Vidro is a possibility of experiencing a collection of a broad historical spectrum. Yet, it is also a connection to their greatest work: the Museum of Art of São Paulo.

The Casa de Vidro safeguards the memory of its patrons, but it is through the Institute that it becomes a living building that is active in the cultural construction of the present. As such, the Management and Conservation Plan structures policies, actions and goals that allow the Bardi Institute the possibility of achieving the objectives for which it was created and maintaining the assets in its custody.

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3rd NOTARY OFFICE. *Endowment deed*. São Paulo, 29 jun. 1995.

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Notes

1 TABET, Marco A. *A respeito de uma vistoria na residência de Lina e Pietro Maria Bardi, realizada em 27 de agosto de 1986*. Landmarking process, p. 53 a 58

2 CARVALHOSA, Modesto S. B. *Síntese de decisão do egrégio colegiado sessão ordinária de 1º. de setembro de 1986*. Landmarking process, p. 59.

3 Minutes of the general meeting of May, 3rd 1990, in which the Institute Quadrante was created.

4 Donation deed, 3rd notary's office, São Paulo-SP, July 29th 1995.

5 Minutes of the general meeting of Instituto Quadrante Administrative Council, São Paulo-SP, March, 19th 1993.

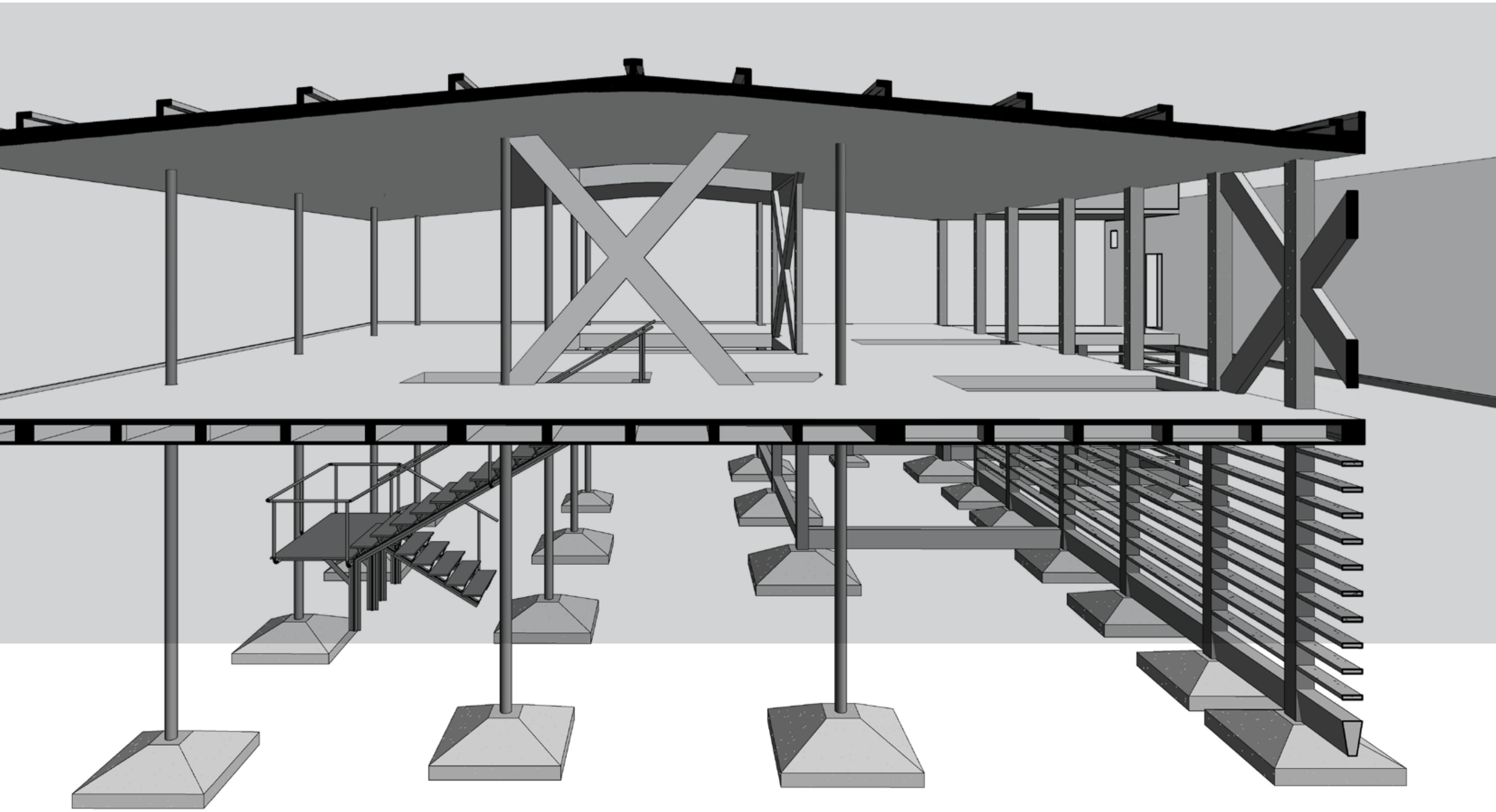
6 The text by Aline C. Sanches, part of this volume, deepens the activities carried out in the maintenance works.

7 The project "Collection of the Lina Bo and P. M. Bardi Institute: cataloging, digitization and assembly of online database" 2009/54901-3 e 2012/50291-9) was implemented between 2011 and 2013. In addition to the funds in the amount of R $ 318,160.15 provided by FAPESP to equip and organize the collection with mapotecas, gradients, sliding wardrobes, tables and computers, were allocated an additional $ 44,995 for works to adapt the electrical network.

8 The abbreviated denomination of the original Lina Bo and P. M. Bardi Institute was associated with the Casa de Vidro at the proposal of architect Sol Camacho in early 2017, when the logo was changed.

9 DEMHIST is short for French "*demeures historiques*", historic houses and names the ICOM International Committee for Historic Homes. For more information, visit the website:http://demhist.icom.museum/shop/shop.php?detail=1255432617

3 Casa de Vidro
Inventory and recommendations for conservation



3.1 Introduction

The inventory consists of organizing surveys to guide conservation and restoration interventions.

As the research form of this project was structured in four specialized teams, the inventory had the function of integrating its surveys, diagnoses and recommendations. Even though there was interaction between the teams during the development of their work, it was only in the inventory production that their products merged.

The effort of synthesis and review allowed the consolidation of the surveys, analyses, diagnoses and recommendations in the following structure:

- Main House (CV)
- Studio (ES)
- Garage (GA)
- Caretaker's House (CC)
- Landscaping (PA)

Each item is organized in the following sort order of component systems:

- Structural
- Sealing
- Architecture
  Finishings
  Roofs
  Frames
  Staircases
  Casements
  Lighting
  Interior archtecture
- Hidraulic instalations
- Electrical Installations

Landscaping, due to its specific characteristics, had a more flexible organization in order to incorporate tree management plans, services organization, proposals of thematic paths of special trees, etc.

The analysis of the accessibility conditions of stairs and ramps is also part of Landscaping. This analysis resulted in guidelines for the design of an accessible auxiliary circulation system, in accordance with Brazilian standards.

Lastly, the inventory presents diagnosis and recommendation concerning the urban and municipal insertion of the Casa de Vidro.

3.2 The complex of buildings and the garden

The Casa de Vidro complex consists of four buildings distributed in three unified lots, totaling 6,713.16 m2 of land area. Situated on a side of the Morumbi neighborhood, near the watershed, the Casa de Vidro was designed to take advantage of the promontory position, opening to the landscape of the Pinheiros River valley.

The main house and the house of the housekeeper were designed and built together, between 1949 and 1952. Later, probably in 1957 (the date was estimated due to lack of records), the garage was built, along with the paths and walls in the garden. The last building was that of the studio, where its collaborators would develop the projects from 1986. Despite the pre-existence of some trees in the highest part of the land, the garden was planted by the architect in the rest of the plot.

The house has its main floor leveled to one of the highest parts of the land, 803 meters above sea level. It detaches from the ground as it advances towards the landscape, creating a platform supported by thin cylindrical pillars. Three of its faces are completely glazed, from floor to ceiling, forming the living room. The back of the room is a masonry wall, which divides the social area from the private area of the residence: bedrooms, bathrooms, closet and hallway. Perpendicular to this wall, the kitchen/dining room extends to the ground level in the back, communicating with the service sector and servants dormitories.

The caretaker's house is located on the eastern slope of the plot, next to Seguidilha street, whose access, despite it being a public road, is restricted. The level is 14 meters below the main floor of the Casa de Vidro. To implant it, the ground was cut and grounded so as to make the garden on the roof slab intersect the sloping ground, giving continuity to the vegetation cover. Windows and door open onto a small terrace, structured by a retaining wall of large granite stones. It guarantees, therefore, that it is not seen from the interior of the main house, disguising itself between the shrub vegetation.

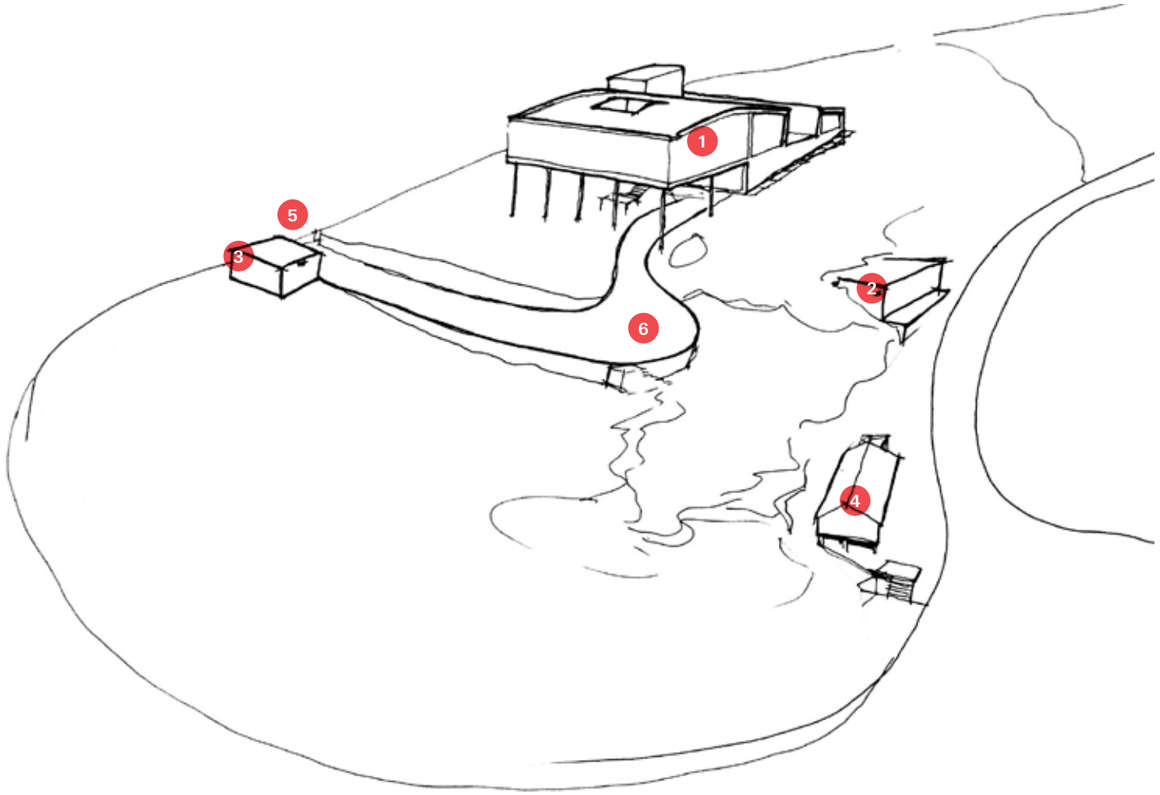
The current garage was built to replace a light, aluminum-framed roof, which was initially built. It already represents the architect's inflection towards a "natural architecture", which mimics the terrain and vegetation. For this, it was constructed as a parallelepiped of structural masonry, with few openings besides the main gate, which opens a whole face of the volume. As in the caretaker's house, a garden roof on a reinforced concrete slab covers the volume, disguising it among the vegetation. The rustic external coating, with rolled pebbles and inlaid ceramic blocks, accentuates the weight of the volume and makes the building part of the ground, like the garden walls. Although located on the other slope of the plot, near the General Almério de Moura street, the garage and the caretaker's house are almost on the same level.

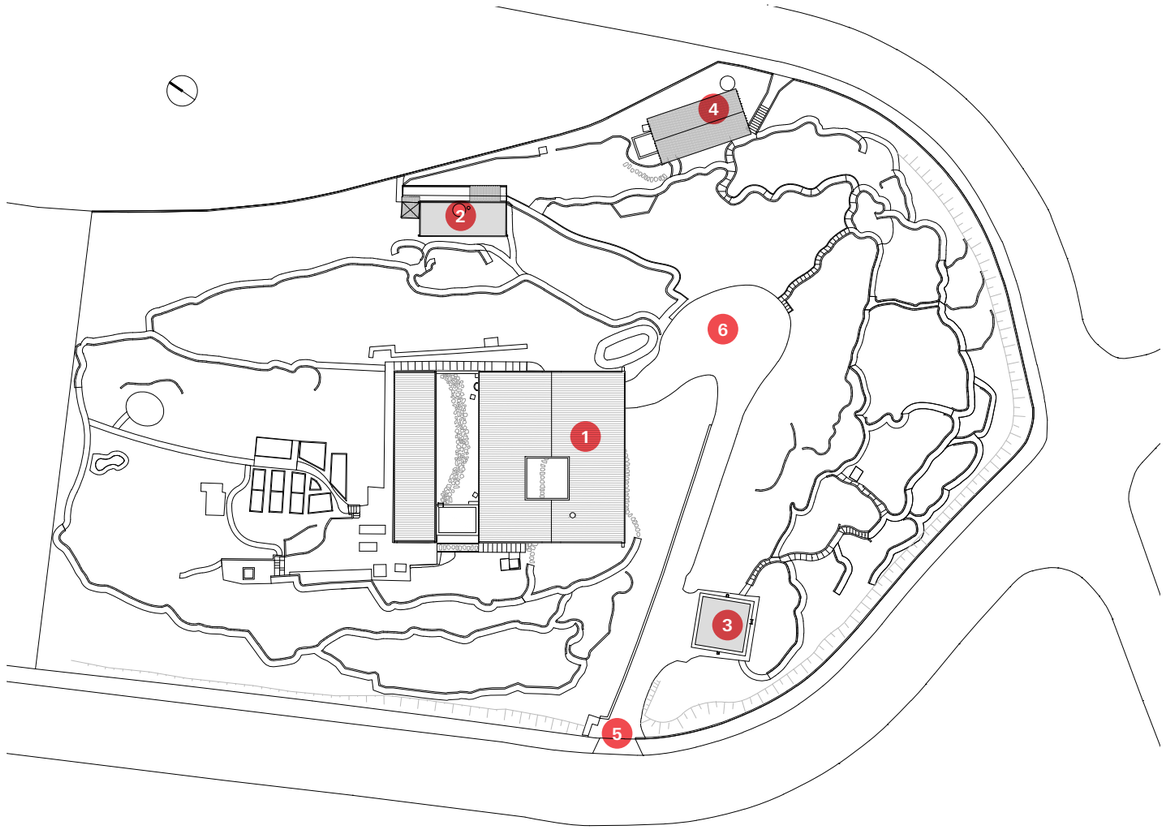
The fourth building of the complex is the studio, situated at the southeast end of the plot of land, 17 meters below the main floor of the Casa de Vidro. A simple construction, mad of wood and covered with a ceramic roof and with a hydraulic module of masonry, it is interconnected with the access ramp of vehicles through a path of sandstone slabs, which is flanked by masonry walls and is supported by a handrail of cast iron. To assist suppliers and facilitate the access for employees, the studio has an independent entrance on the Bandeirante Sampaio Soares Street.

The arboreal mass of the garden was planned by the architect, since the plot of land had few trees when the house was built. Several built elements make up the garden. On the concrete floor level at the back of the main house, an oven and a barbecue repeat the white of the architecture and suggest the outdoor extension of the kitchen activities. Sinuous paths of stone slabs and masonry walls, lined in the same way as the garage, meander through the plot, configuring some areas with large, flat floors as possible seating places in the garden.

The whole plot was surrounded by a masonry wall of apparent blocks, built by determination of the Municipality late in 1978, along with the sidewalks. Until then, a faint wire fence separated the property from public space – records of other times of the city and of the Morumbi neighborhood.

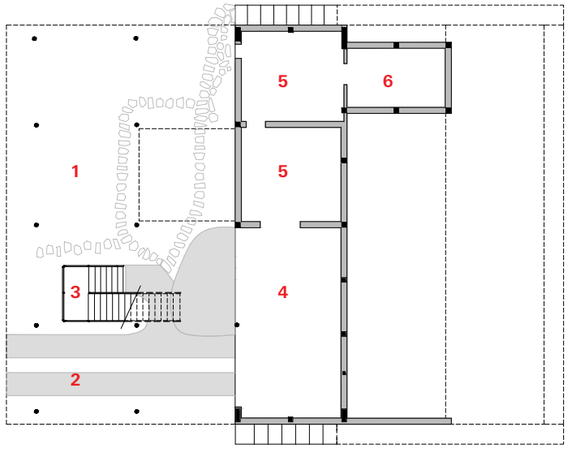
Plan site



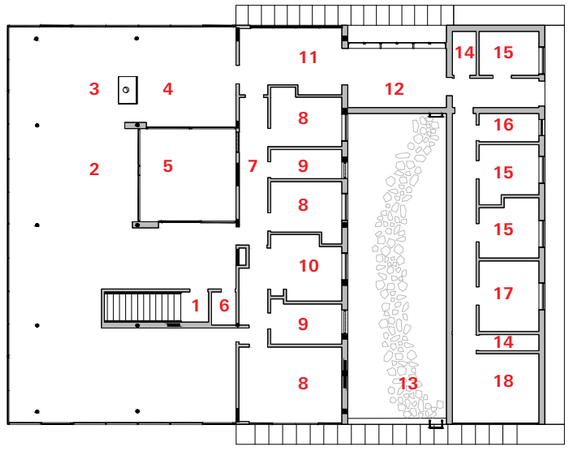


1 Main House
2 Caretaker's House
3 Garage
4 Studio
5 Main entrance
6 Access ramp

Casa de Vidro (Main House)

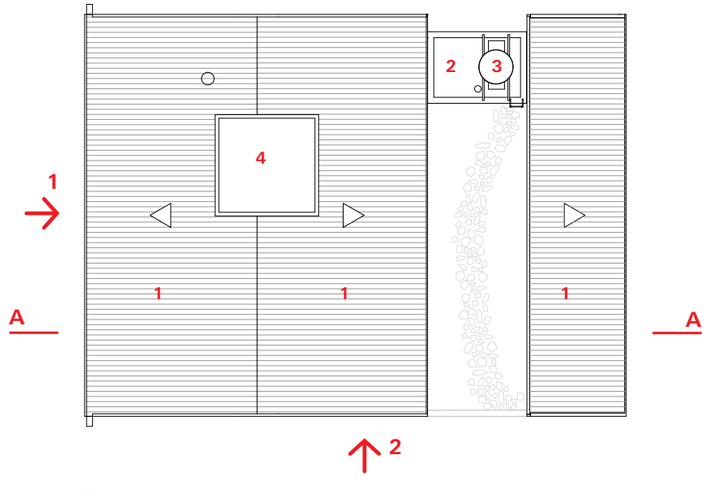


1 Garden
2 Parking space
3 Stair
4 Veranda
5 Storage
6 Machine room



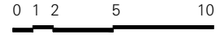
Plan of main floor

1 Stair
2 Living room
3 Fireplace/internal chimney
4 Dining room
5 Open space
6 Lavatory
7 Corridor
8 Bedroom
9 Bathroom
10 Dressing room
11 Pantry
12 Kitchen
13 Garden
14 Pantry
15 Maid's room
16 Bathroom
17 Laundry room
18 Veranda / Service

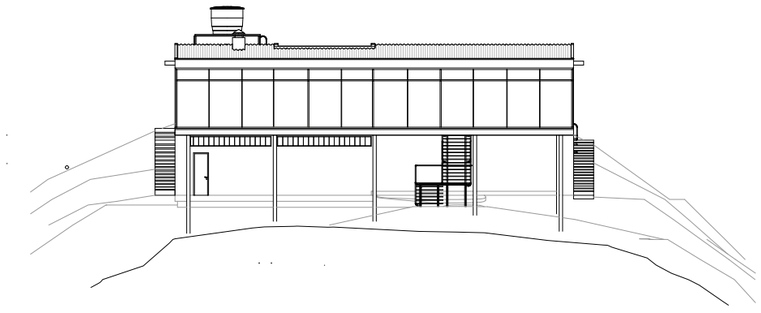


Roof

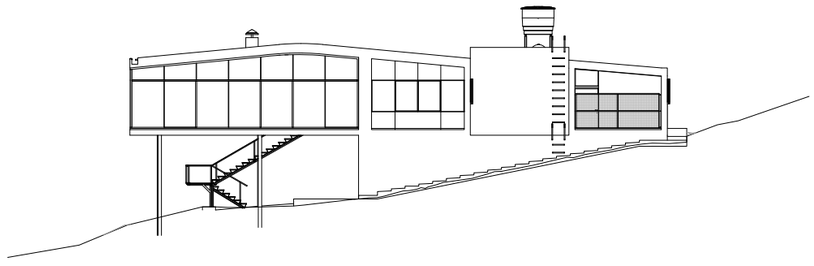
1 Roofling corrugated tiles
2 Rooftop garden
3 Water tank
4 Open space



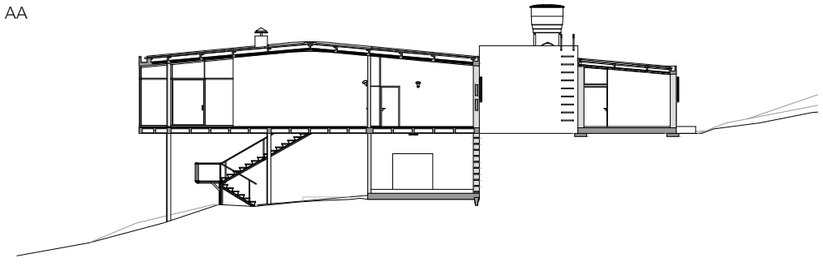
View 1



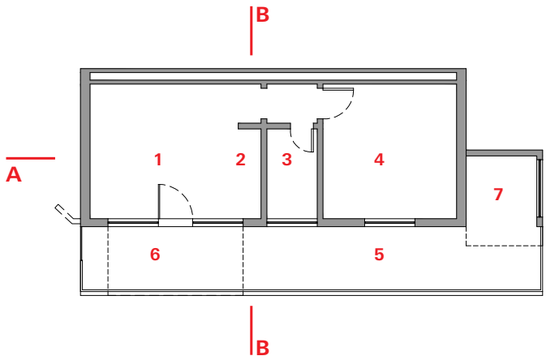
View 2



Section AA

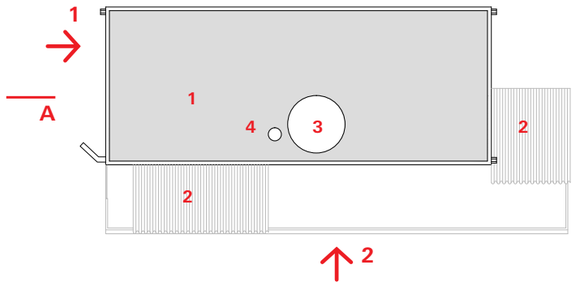


Caretaker's House



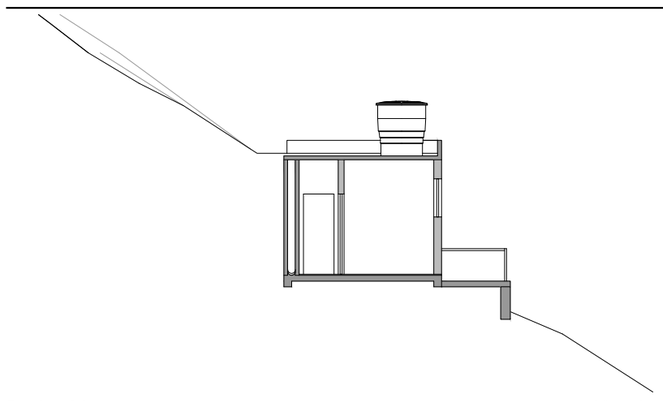
Plan of ground floor

1 Living room
2 Kitchen
3 Bathroom
4 Bedroom
5 Balcony
6 Porch
7 Services



Plan of roof

1 Rooftop garden slab
2 Roofling corrugated tiles
3 Water tank
4 Chimney



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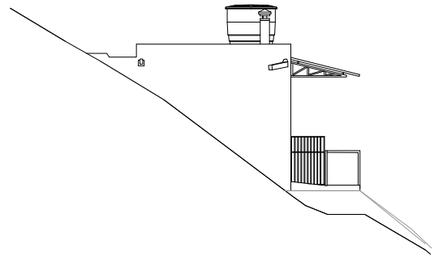
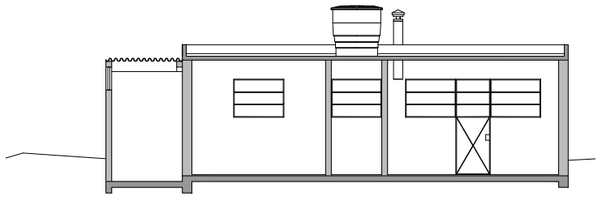


View 1



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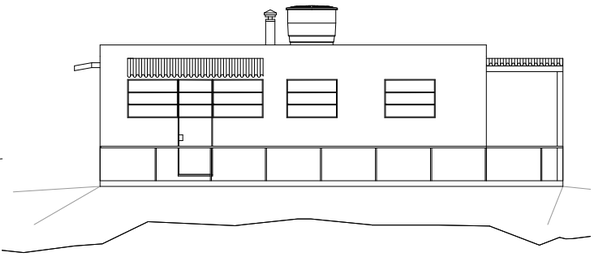
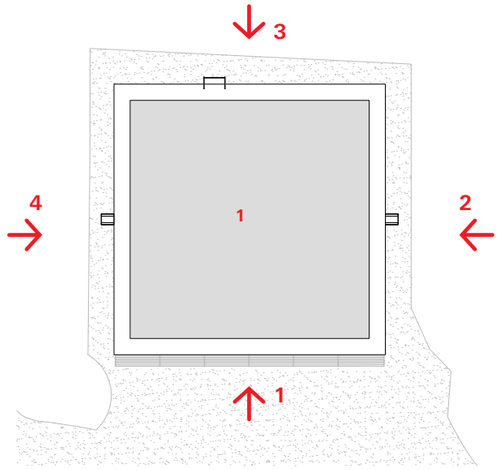


View 2

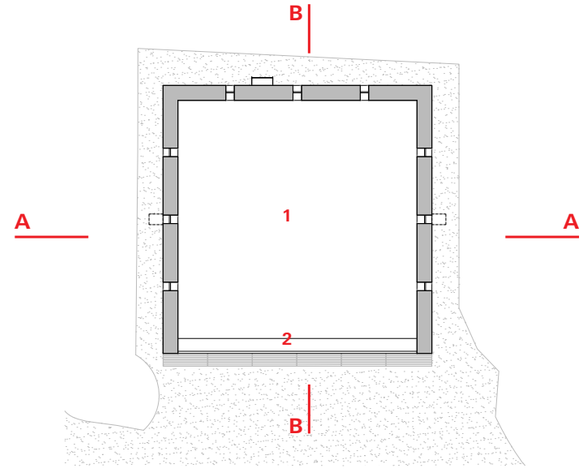
0 1 2 5

Garage



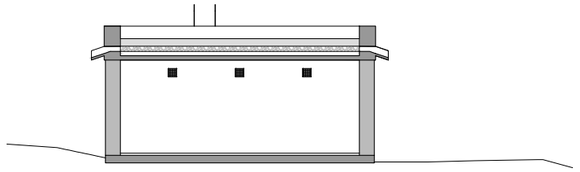
Plan of roof

1 Rooftop garden slab



Plan of ground floor

1 Room
2 Gate



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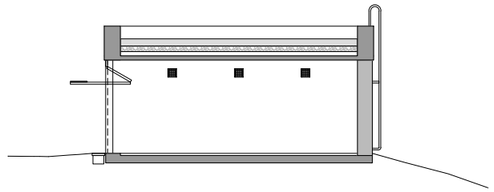

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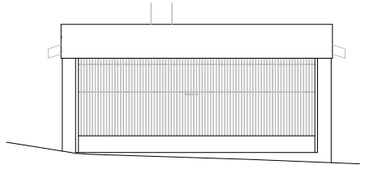

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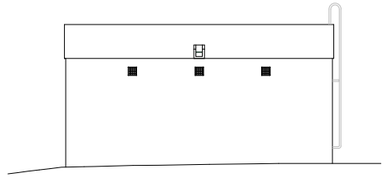
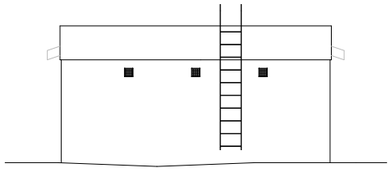
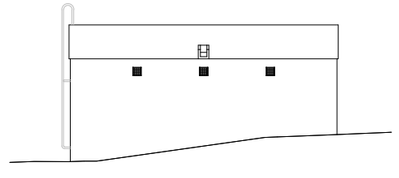


View 2



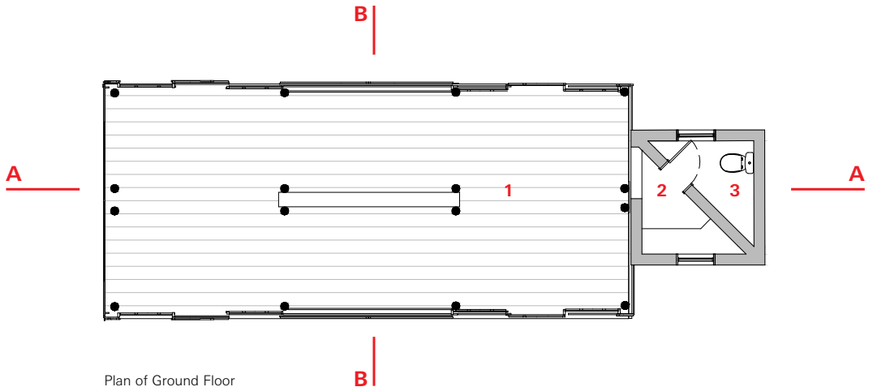
View 3



View 4

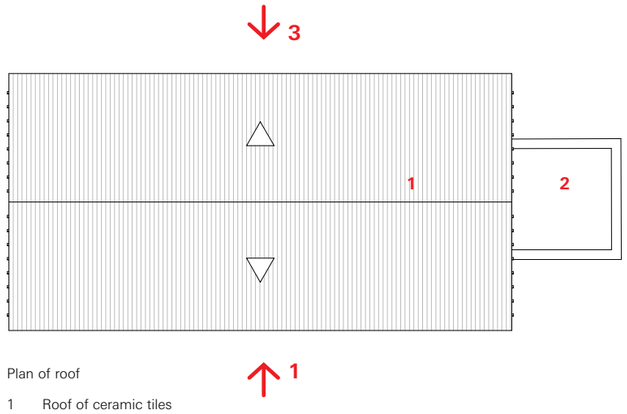
0 1 2 5

Studio



Plan of Ground Floor

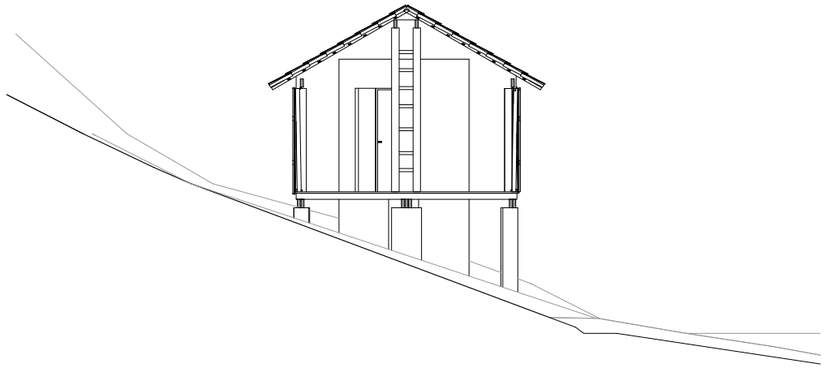
1 Working room
2 Kitchen
3 Lavatory



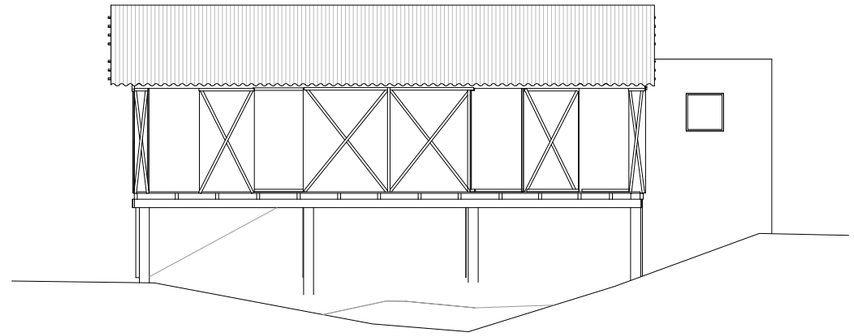
Plan of roof

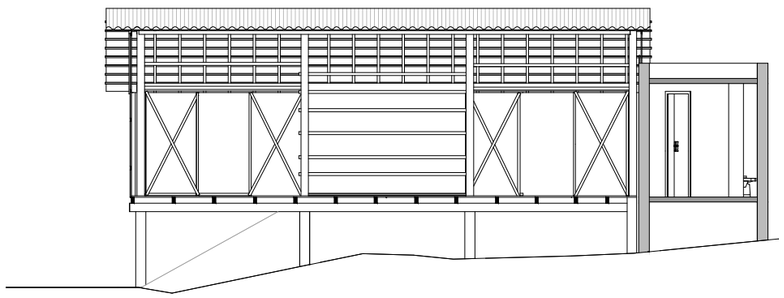
1 Roof of ceramic tiles
2 Rooftop garden slab

Section BB

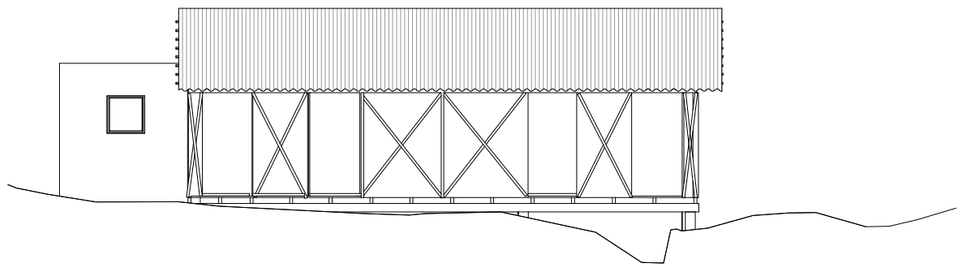


View 1



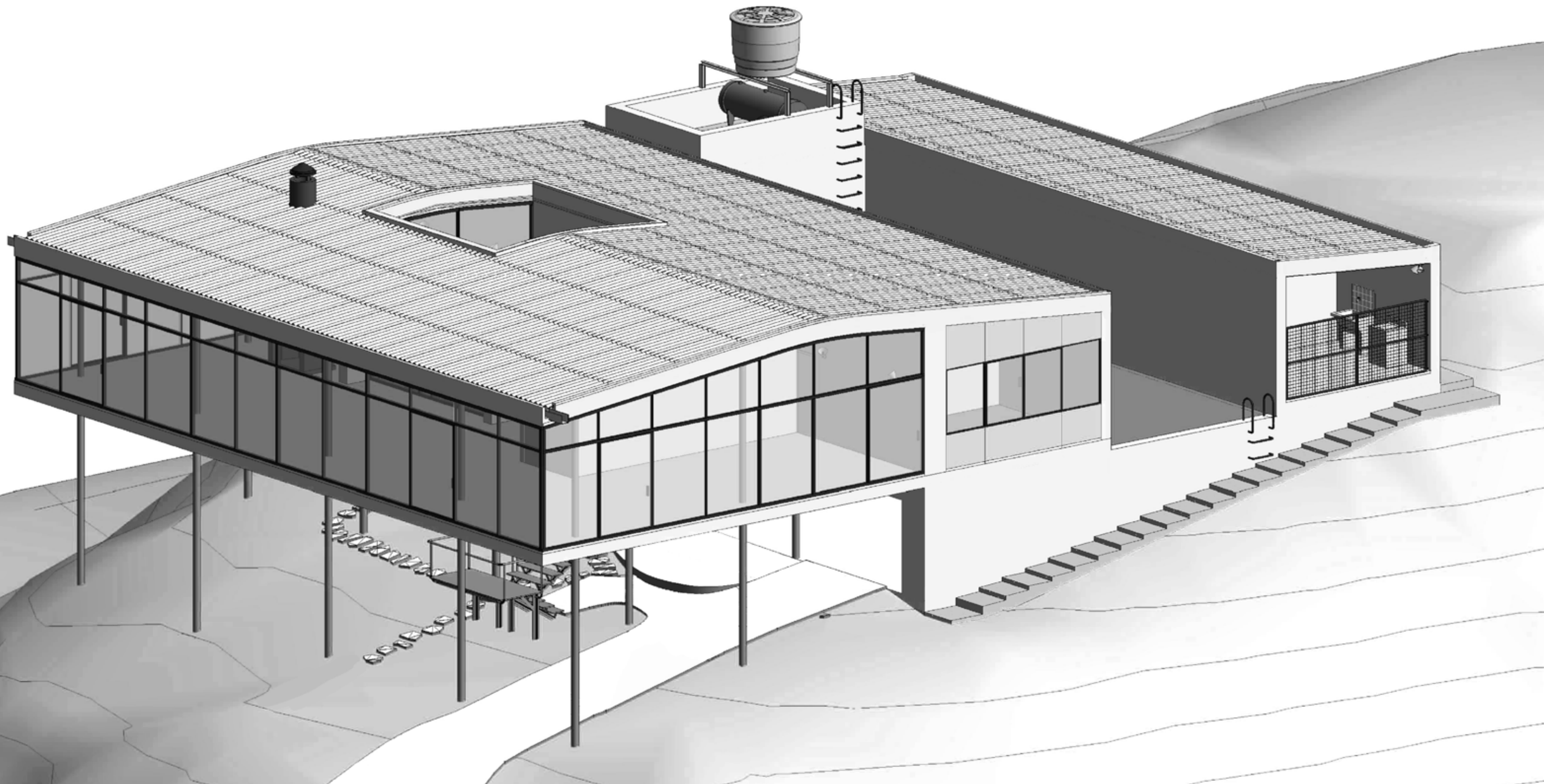


Section AA



View 2

3.3 Main House
CV



Structural System
CV.01

Description

Components
structural system, mixed structure

Description
Isolated footings under the pillars in the area of the pilotis and footings interconnected by wedge-shaped grade beams in the technical area and storage areas. Inspections of the pillars' bases in the pilotis area with excavations down to where they connect to the footings demonstrated the solid state of the steel pillar, even while buried in a very humid environment.

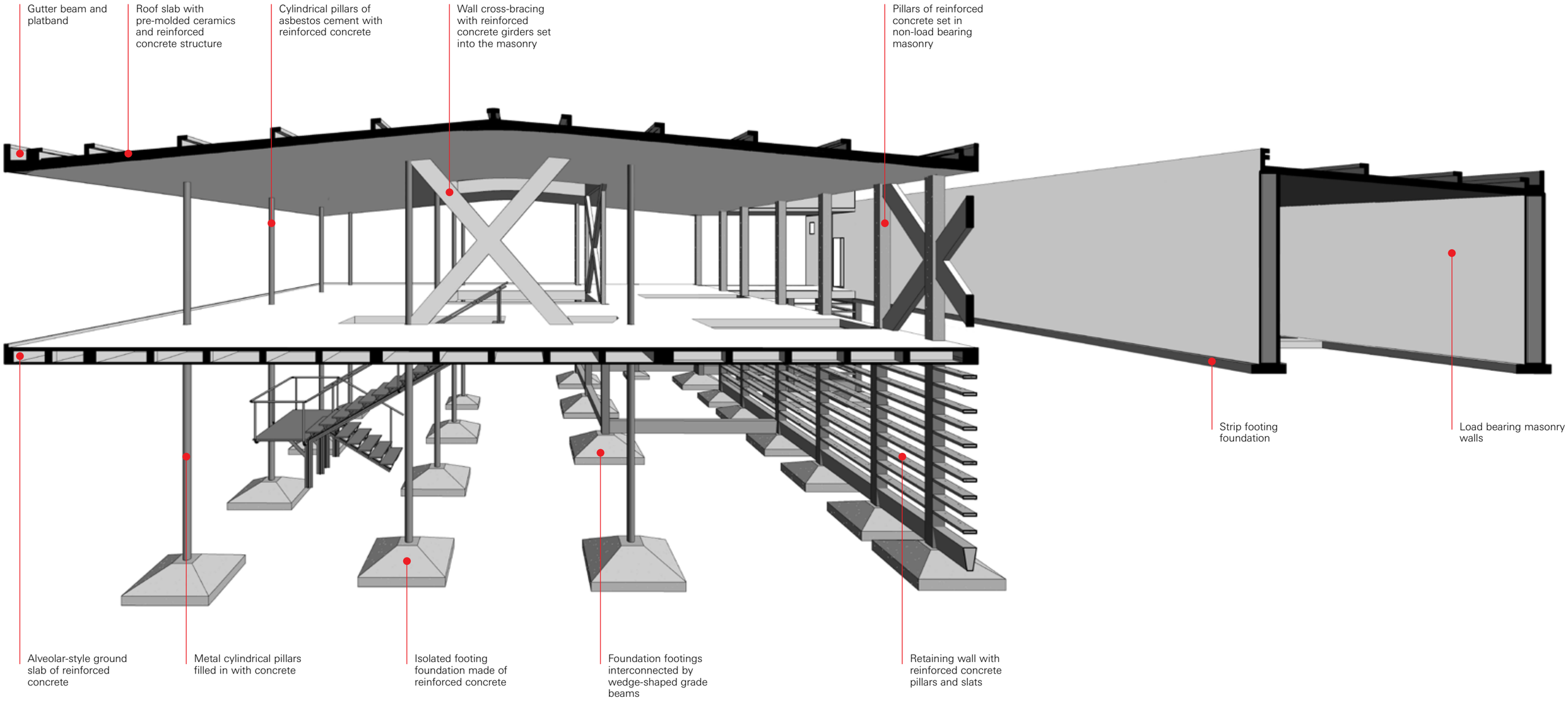
In the sections of ground above the retaining wall with a shallow foundation of reinforced concrete strip footing under the load-bearing masonry wall.

Support
Masonry retaining walls seated upon a structure of reinforced concrete beams and pillars. Slats (belts of reinforced concrete) every 25 centimeters throughout the entire height of the retaining wall interconnect the embedded pillars, coated together with the masonry.

Cylindrical steel-tube pillars were filled in with concrete in the pilotis.

The ground slab's main metalwork rises out of the internal concrete up to the pillars, "looking like an umbrella," according to Lina Bo Bardi. Stretching up to the living room ceiling, the cylindrical pillars of reinforced concrete are enclosed in tubes of asbestos cement and from them comes the metalwork set into the beams of the rooftop slab. In the other areas – kitchen and laundry/service areas – the reinforced concrete pillars are embedded and coated in mortar, and in the laundry/service area there is load-bearing masonry.

The ground slab is ribbed in reinforced concrete and alveolar with the lower alveolar lined in reinforced mortar. Roof slab with system of ceramic flagstones, (pre-slab) joists re-clad in situ and inverted reinforced concrete beams. In the block of the laundry/service area the roof slab is supported directly by the masonry.



Structural System
CV.01

Description

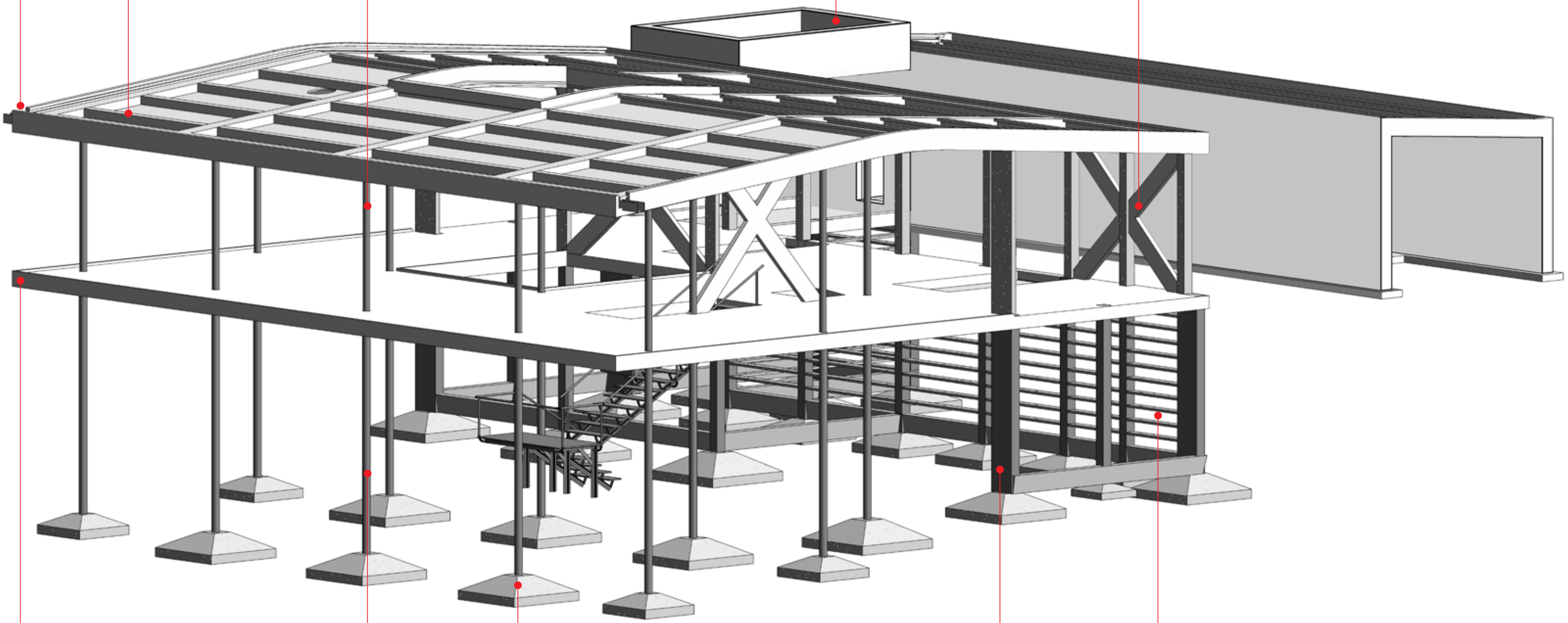
Gutter beam and platband

Roof slab with pre-molded ceramics and reinforced concrete structure

Cylindrical pillars of asbestos cement with reinforced concrete

Garden slab

Wall cross-bracing with reinforced concrete girders set into the masonry



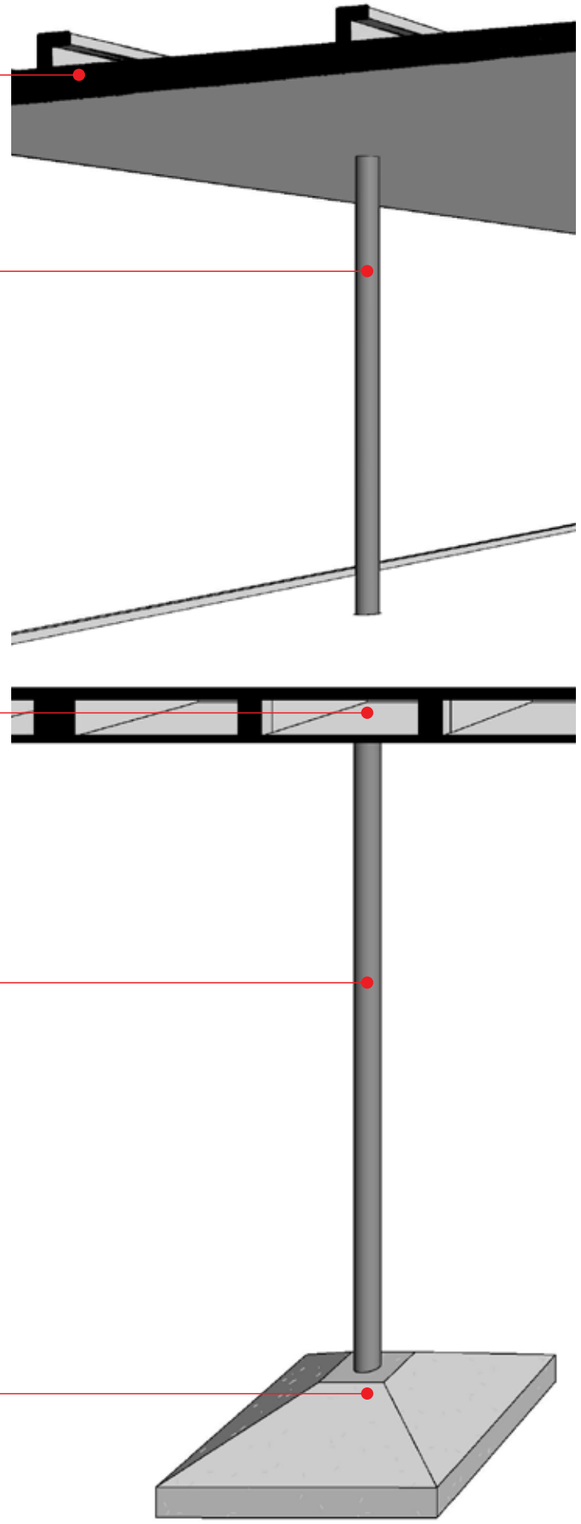
Alveolar-style ground slab of reinforced concrete

Metal cylindrical pillars filled in with concrete

Isolated footing foundation made of reinforced concrete

Foundation footings interconnected by wedge-shaped grade beams

Retaining wall with reinforced concrete pillars and slats



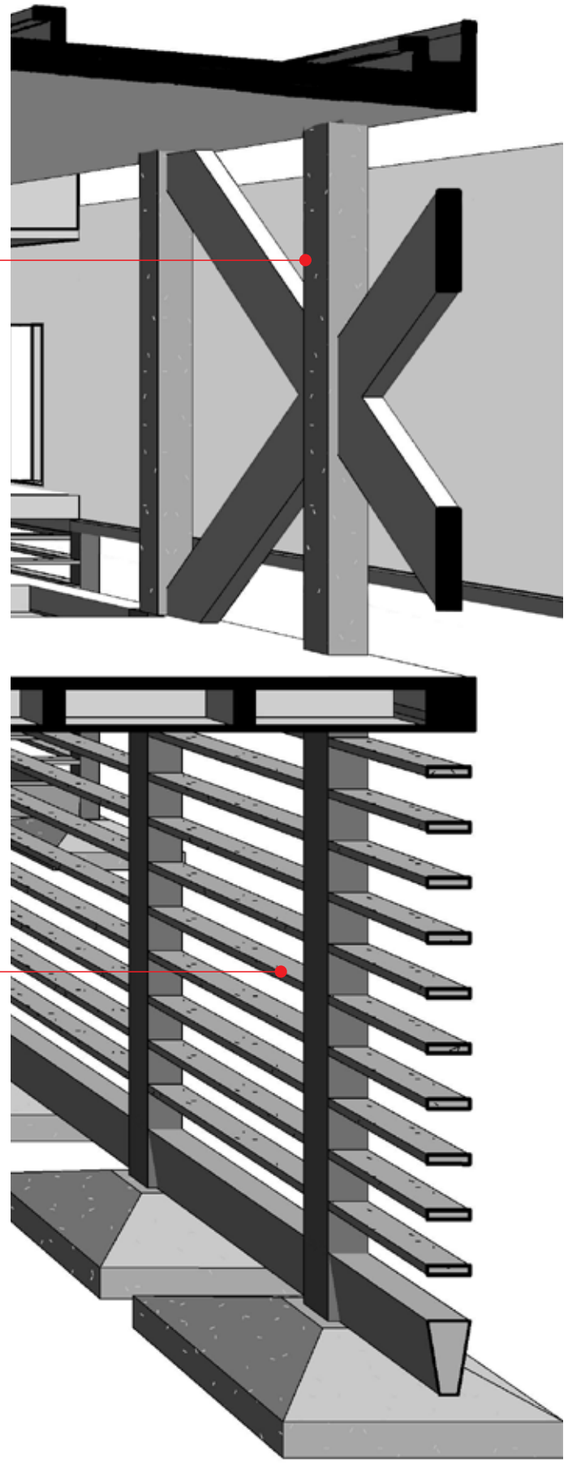
CV.01.09
Rooftop slab

CV.01.03
Reinforced concrete pillars in tubes of asbestos cement.

CV.01.08
Ground slab between levels

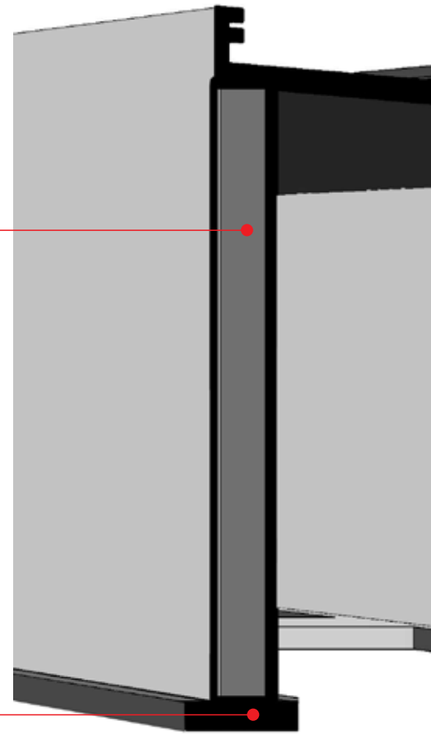
CV.01.02
Cylindrical pillars in steel tube

CV.01.01
Isolated footing foundations



CV.01.05
Reinforced concrete pillars and wall bracing

CV.01.04
Retaining wall



CV.01.07
Load bearing masonry wall

CV.01.06
Strip footing

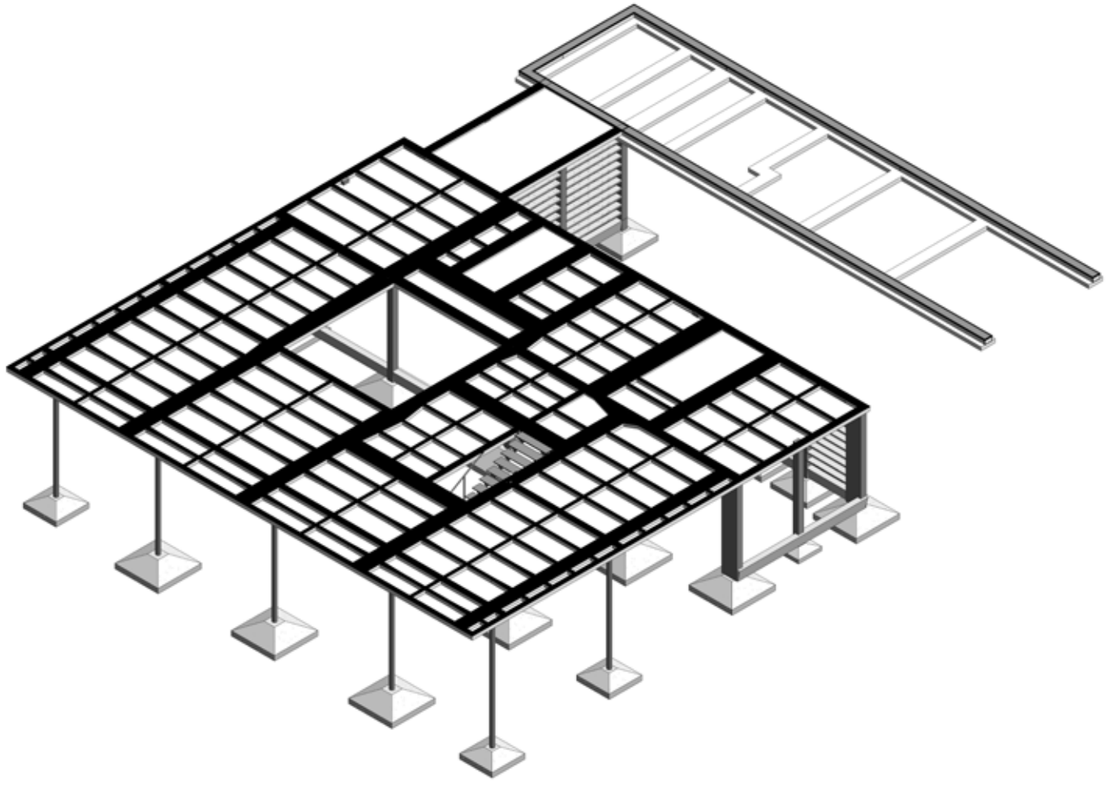
Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.01.01	Isolated footing foundations	Isolated footings under pillars in the area of the pilotis and footings interconnected by wedge-shaped grade beams in the technical area and storage deposits.	Surveys of the pillars' bases in the area of the pilotis with excavations down to where they connect with the footings demonstrate that the pillar steel is in good condition, despite being buried in a very humid environment.		
CV.01.02	cylindrical pillars in steel tube	Cylindrical pillars in steel tube, 18.3 cm in diameter and 10 mm thick, filled with concrete in the lower slab of the pilotis.	The metalwork in the two types of cylindrical pillars is unknown due to fact that this page is missing from the structural project. According to statements made by Lina Bo Bardi, the main metalwork in the beams and ground slab stretch from inside the concrete of the upstairs floor down to the cylindrical pillars below, where the metalwork from the upper pillars are set, stretching up to the beams of the rooftop slab. The pillars were painted bluish-gray (cor 5415 M, Pantone system). An evaluation of the existing tubular pillars of mixed steel-concrete subjected to solicitations of structural modeling confirmed the structural safety of the components. The surveying of a pillar demonstrated wall thickness of 9.84 mm, compatible with the specification, which is 10 mm. The digital surveying conducted by laser identified that the pillars on top of the main floor are not exactly of the same, original plumb in the pilotis-- in other words, they are not concentric, but the displacements are not severe enough to generate risk.	The metallic pillars present oxidation limited to the sacrificial layer and degradation in the coat of paint. The general conditions are very good and the prospections into the bases of the pillars in the area of the pilotis, with excavations down to where they connect with the footings demonstrate that the pillar's steel is in fine shape, even though buried in a humid environment.	It is necessary to remove the points of oxidation in order to prevent continuous structural damage. Conduct a cleaning process, chemically removing the oxidized particles and scraping the paint down to the base of the pillars where they connect with the foundation footings, removing the old paint and applying a base of antioxidant protection with epoxy paint in original color.
CV.01.03	Reinforced concrete pillars in tubes of asbestos cement	Reinforced concrete pillars enclosed in tubes of asbestos cement with a diameter of 14.6 cm on the upstairs floor.			

Pillars with oxidation pushing out the layer of paint

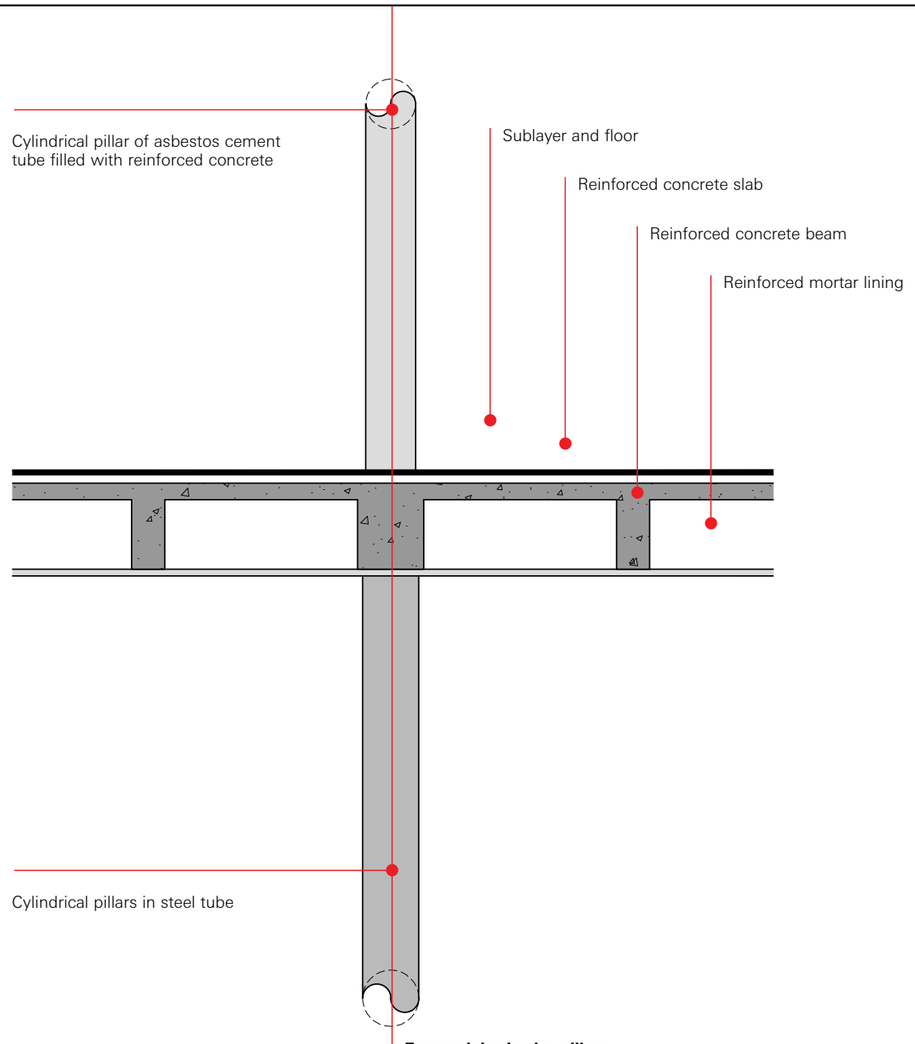
Excavations down to the foundation footing

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.01.04	Retaining wall	Retaining walls of masonry based on a structure of reinforced concrete beans and pillars. Slats (belts of reinforced concrete) every 25 cm all throughout the height of the retaining walls interconnect the embedded pillars, coated together with the masonry.			
CV.01.05	reinforced concrete pillars and wall cross-bracing	Reinforced concrete pillars embedded in the masonry of the lower floor (technical area and veranda) and in the area of the bedrooms, bathrooms and kitchen on the upper floor. Wall cross-bracing constituted of reinforced concrete beams situated between pillars on the upper floor.	Tests realized with a sample of the concrete removed in situ show that the phenomenon of carbonation did not reach the reinforcing steel, which allows us to conclude that the steel remains preserved and the structure is intact. Two of the three wall bracings are situated at the breaks in the slab – the staircase and open patio.		
CV.01.06	Strip footing	In the ground sections in back, a shallow foundation of reinforced concrete strip footings under a load bearing masonry wall.			
CV.01.07	Load bearing masonry wall	The two longitudinal walls of the posterior volume, designated for laundry and cleaning, constitute load bearing masonry walls of solid “brick,” 30 cm thick, supported on the foundation of reinforced concrete strip footing.	The walls show no signs of structural pathology.		

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.01.08	ground slab between levels	Reinforced concrete alveolar slab lined in reinforced mortar which conceals the beams/ribbing. Ground slab 5 cm thick and lined slab 2 cm thick. Slabs lowered for the installation of sewage drains in the kitchen and bathrooms filled up to the level of the floor.	Survey realized confirmed the slab's measurements and good state of preservation, including the shape of the wood alveolar, conserved on the inside.		Observe for the appearance of signs of oxidation, correcting them according to the item Finishings.



System of beams inside alveolar slab, revealed in perspective without the ground floor slab.



Eccentricity in the pillars identified in survey. The beam accommodates the misalignment.

Conclusions of the official appraisal of structural capacity issued by civil engineer Ricardo Couceiro Bento.

Based on studies executed with the use of structural analysis software, verification of the structure in situ (visual and extraction of specimens) and existing blueprints, the following conclusions were drawn:

The structure is in a satisfactory state of conservation, given the age of the construction, and the carbonation process has not yet reached the reinforcement of the concrete structure.

With regard to the Ultimate Limit State (ULS), obtained by comparing the current analysis with the original structural design, according to the details and hypotheses adopted in the evaluation, the structure is considered safe for vertical accidental overload in the floor of 3 kN/m² (300 kg/m²), which equals an occupancy of 42 people in 10 m². Regarding the detailing of the reinforcement, some variations were verified, as expected, which are not significant to the point of non-approval of the structure.

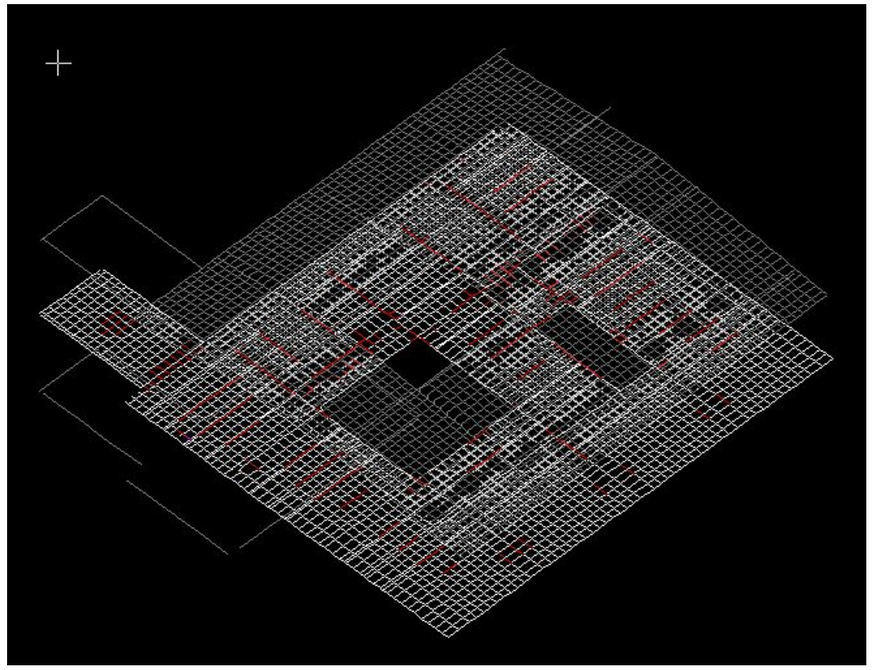
Based on the observances made in the foundations and the structure of the house, together with the data of the original projects and these, compared to the results of the loads of the current structural project, the conclusion is that, with regard to foundations, these are safe in what concerns the requests for the intended use.

The assessment of the existing composite steel and concrete tubular columns, submitted to the structural modeling requirements, presented results that confirmed the structural safety.

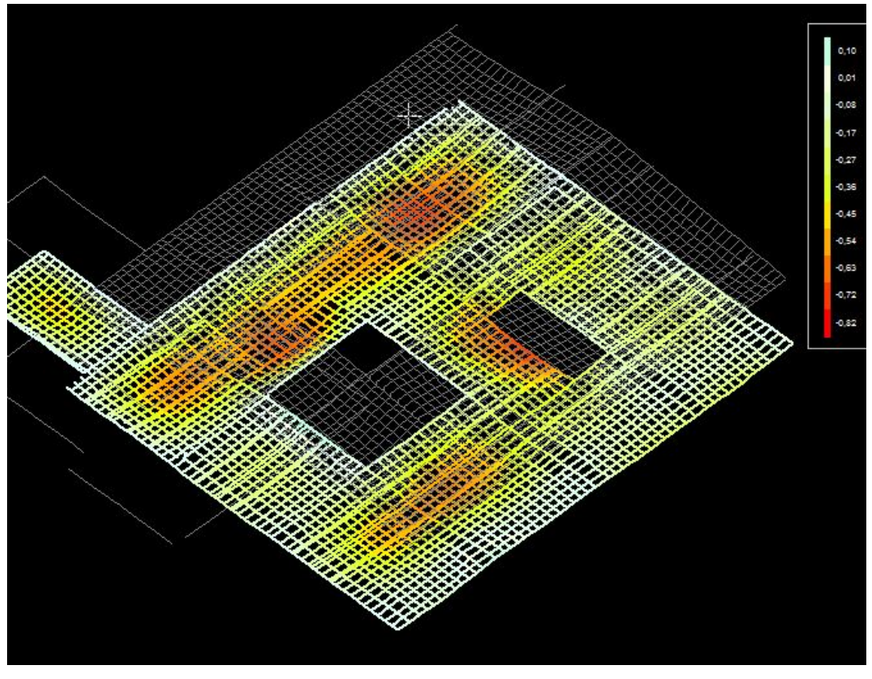
By evaluating the results of the structural modeling of the columns in reinforced concrete, the supporting columns of the floor slab of the upper floor are all in accordance with their dimensions and slenderness.

With respect to the State Service Limit (SSL), values of structure displacements and deformations of the beams and slabs (through non-linear grid analysis) were found within the limits of the current standardization.

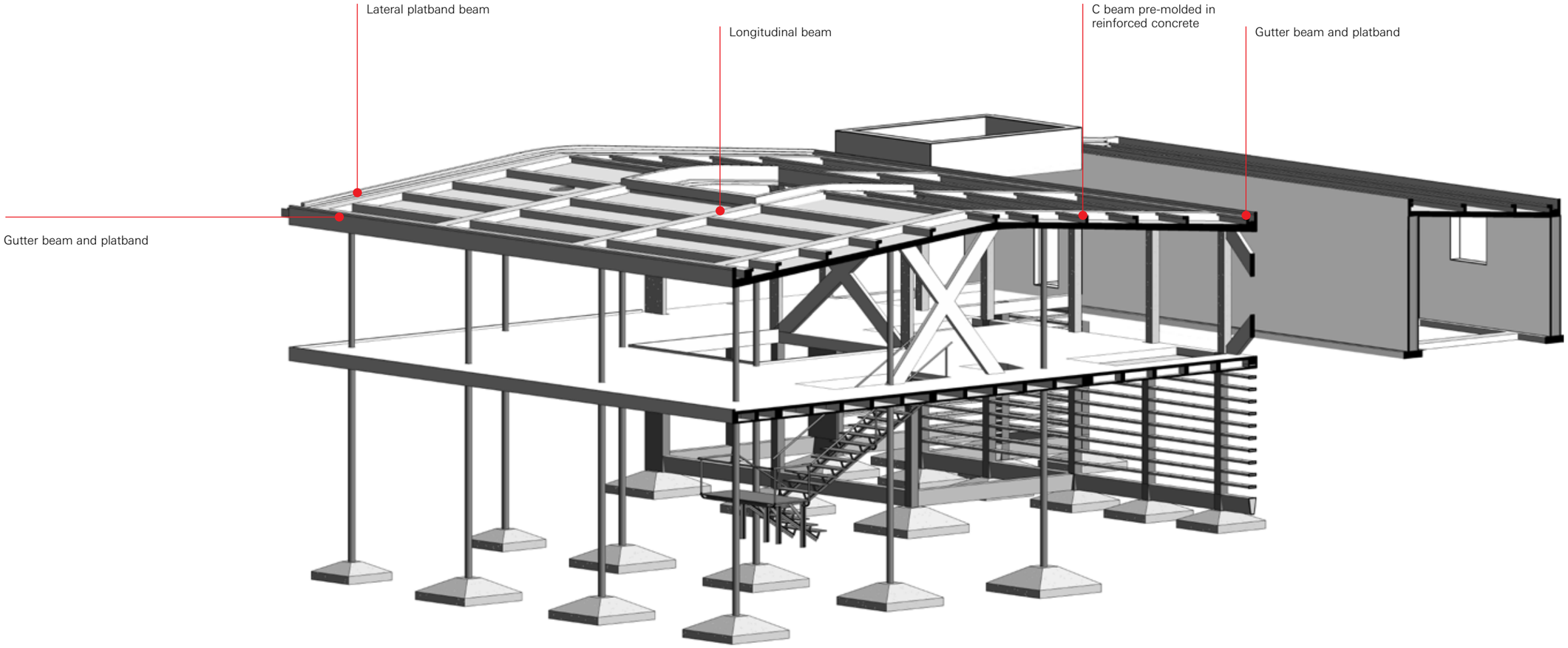
Non-linear grid analysis of the ground slab: bars of the grids.



Deformations in the slabs (without fluency).

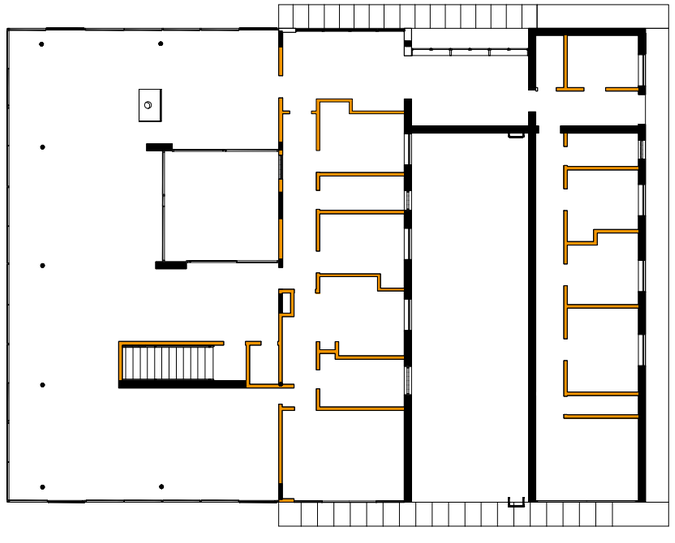


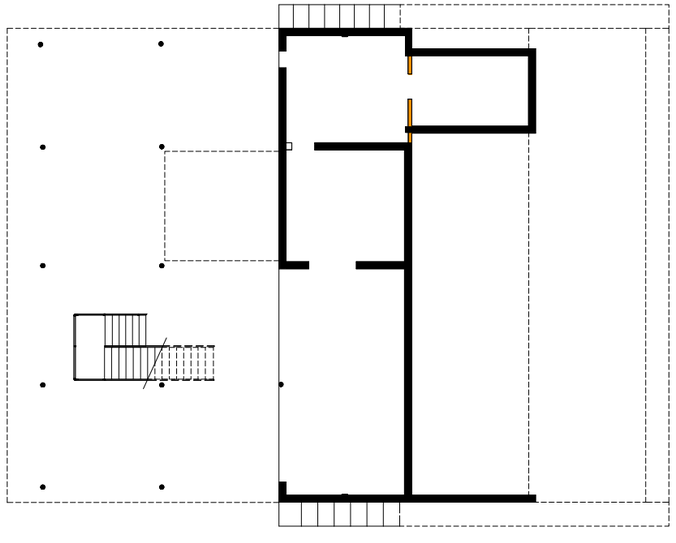
Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.01.09	rooftop slab	Rooftop slab with system of ceramic flagstones and (pre-slab) joists re-clad in situ, supported by inverted girders of reinforced concrete, which, on the exterior sides, serve as border girders that form the platbands. On the inclined lateral beams and at the top of the structure designated for laundry and cleaning, the beam opens into a C to function as casings for the tiles. The lower lateral beams contain the gutters.	The structure of the rooftop slab appears intact, with no points of compromise.		Observe for the emergence of signs of oxidation, correcting them according to the item Finishings.



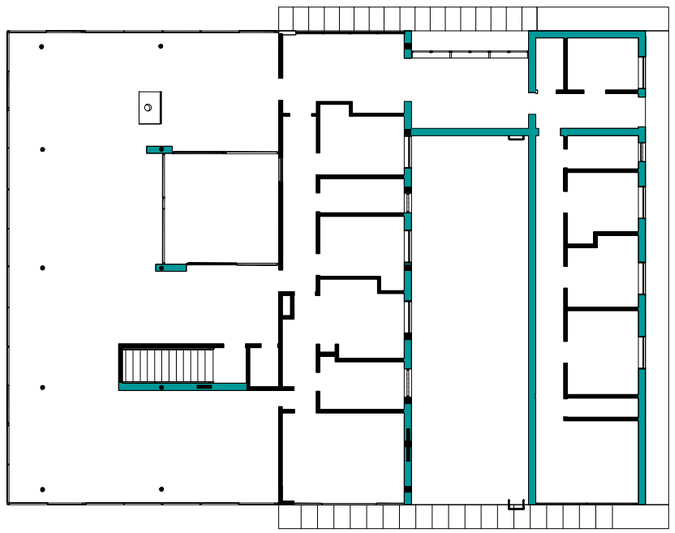
Isometric perspective of the structure

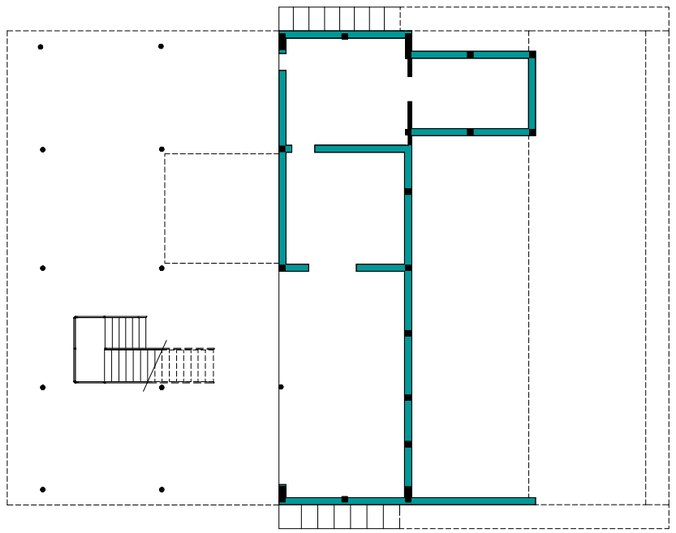
Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.02.01	half brick masonry walls	Solid brick walls 15 cm thick, finished (see item Architecture Finishings).	The walls show no signs of pathology.		

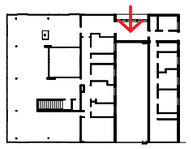




Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.02.01	one brick walls	Walls of solid brick, 30 cm thick, with or without set pillars, finished (See item Architecture Finishing).	The external walls display problems only in their finishings.		

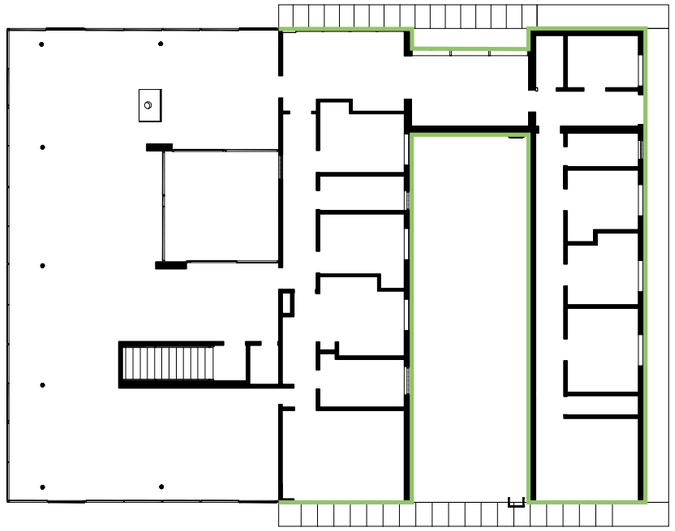


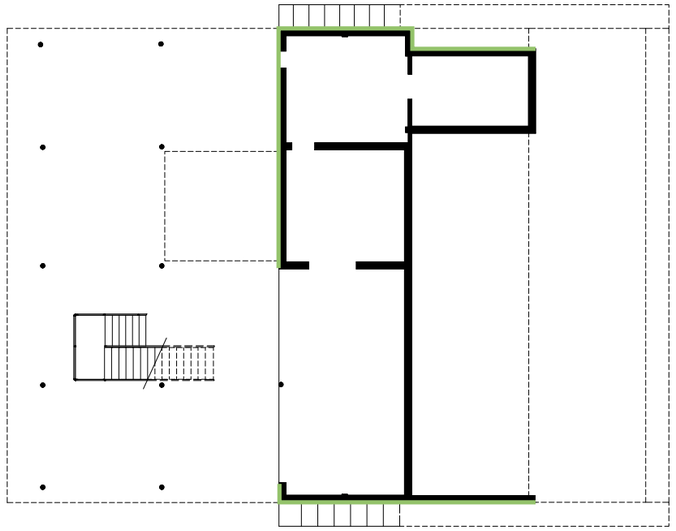


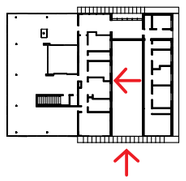


Fungi, stains and cracks. Displacement of mortar, efflorescence, fissures and detachment of finishing.

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.01.01	whitewashed external walls	Walls clad in roughcast, dash and wall plaster finishing, painted with lime.	Fungi, stains and cracks. Displacement of mortar, efflorescence, fissures and detachment of finishing.	Damage caused by the humidity in the atmosphere and lack of eaves to impede the entrance of rainwater.	Annual maintenance with manual sanding of the mortar and posterior washing using water jets with chlorine, removal of loose material and replacement of missing mortar. Paint over with lime.





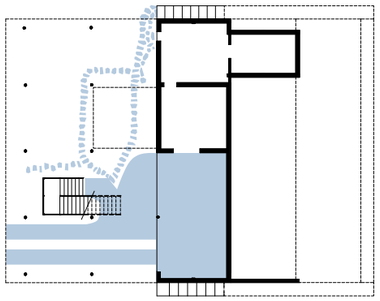


Fungi, stains, cracks and detachment of the finishing and peeling paint on the external walls

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.01.02	finishing on internal walls in the technical area. Retaining wall and water tank	Walls clad in roughcast, dash and wall plaster finishing, painted with lime.	Fungi, stains and cracks. Displacement of mortar, efflorescence, fissures and detachment of finishings.		Annual maintenance with manual cleaning of mortar (sanding), and posterior washing using water jets with chlorine, removal of the loose material and replacement of missing mortar. Repaint the veranda area with lime and the technical area with latex.
CV.03.01.03	finishing on internal walls plastered and painted	Internal surfaces with original fine grained mortar with sand of unverified origin. Portions already recomposed with mortar of similar grain on previous occasions. Paint with latex in white color.	Good state of maintenance.		Regular cleaning.
CV.03.01.04	finishing of 15 x 15-cm smooth white tiles	Generally good conditions with small cracks that should be maintained. Curved accessories for change in direction of the same quality.	Tiles loose from the base mortar and cracked tiles. Tiles have already come loose, some pieces missing.		Avoid altering the set as much as possible, only where it is strictly necessary, remove loose pieces with complete reutilization of tiles and reset them in the original position. Look for identical pieces to replace those that are missing.
CV.03.01.05	walls finished with Vidrotil tiles	Walls of the half bathroom and the suite bathroom finished in green Vidrotil tiles in a good state of conservation.	After maintenance completed by supplier in 2008, the floor displays a solid state of conservation. Some pieces were reset poorly.		Replace the missing pieces and once again re-grout according to the material's specifications. Cleaning should be executed with water and neutral detergent. Utilize a clean, moistened soft sponge and finalize the process with a dry cloth. Do not use a piassava straw broom or any other product that has steel in its composition as it could scratch, damage or remove the shine of the finishing. Due to the recent closure of the only company supplying this material, any pieces to come loose should be kept whenever possible, as there are no other similar pieces on the market to replace them.

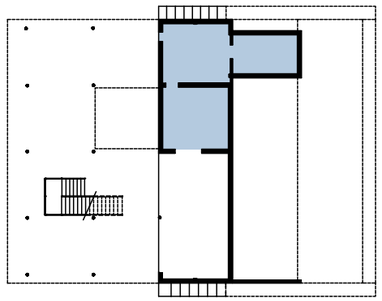
Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.02.01	Vidrotil tile floor	Floors in living room areas, bathrooms and kitchens done in Vidrotil tiles in good state of conservation. Living room area: azure Kitchen: black Shared bathroom: white In-suite bathroom: dark blue	After maintenance conducted by supplier in 2008, the flooring displays a good state of conservation. Some pieces were reinstalled poorly.		Replace the missing pieces and once again re-grout according to the material's specifications. Cleaning should be executed with water and neutral detergent. Utilize a clean, moistened soft sponge and finalize the process with a dry cloth. Do not use a piassava straw broom or any other product that has steel in its composition as it could scratch, damage or remove the shine of the finishing. Due to the recent closure of the only company supplying this material, any pieces to come loose should be kept whenever possible, as there are no other similar pieces on the market to replace them.
CV.03.02.02	ceramic flooring	Red ceramic flooring, 7 x 7 cm tiles in laundry/cleaning area. Ceramic threshold on the external door with sill.	Occasional bulges and broken or loose pieces.	Possible thermal dilation in sublayer and impact caused by fallen objects.	Replace missing pieces, preserving the original flooring, including broken pieces. Conserve the original flooring as much as possible, as there are no other similar pieces on the market to replace them.
CV.03.02.03	wood blocks	Blocks of white peroba (paratecoma peroba), 5 x 15 cm in size, in the bedrooms, corridor and closet. Checkered pattern with smooth wood baseboards. Blocks protected with Synteko and baseboards painted white.	Good state of conservation, but some appearance of moisture stains in parts, as well as loose pieces.		Inspect and fix any infiltrations. Avoid any action aside from the resetting of loose pieces. In the future, in the event of wear on the wood's protective layer, hire specialized service to sand and recompose the layer of Synteko.
CV.03.02.04	external flooring on pilotis	Flooring of pink sandstone with mortar grouting and encrusted with tumbled pebbles.	Well conserved, some blocks are loose and others stained with motor oil.		Reset the blocks with mortar. Clean the motor oil with the chlorine-based "Limpa Pedras."

Code	Component
Wall CV.03.01.01	External whitewashed walls
Floor CV.03.02.04	External flooring on pilotis



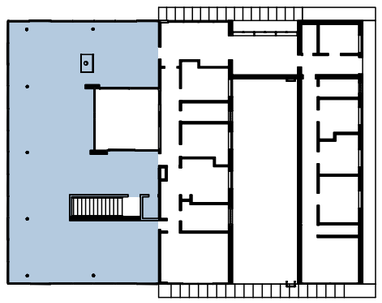
Floor of pink sandstone blocks with mortar joints and encrusted with tumbled pebbles.

Wall CV.03.01.02	Finishing on internal walls in the technical area. Retaining wall and water tank
Floor CV.03.02.02	Ceramic flooring



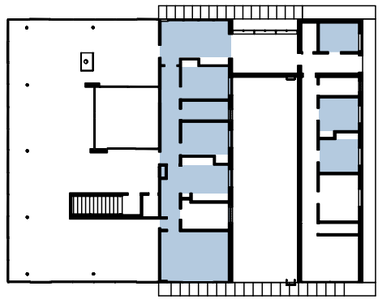
Red ceramic flooring with broken portions in the technical area

Wall CV.03.01.03	Finishing on internal walls plastered and painted
Floor CV.03.02.01	Vidrotil tile flooring



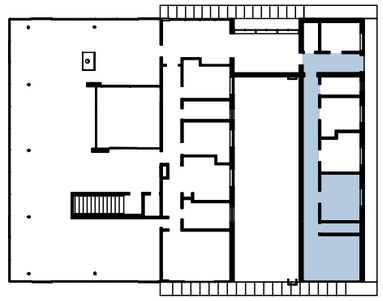
Floor of azure Vidrotil tiles in the living room

Code	Component
Wall CV.03.01.03	Finishing on internal walls plastered and painted
Floor CV.03.02.03	Wood blocks

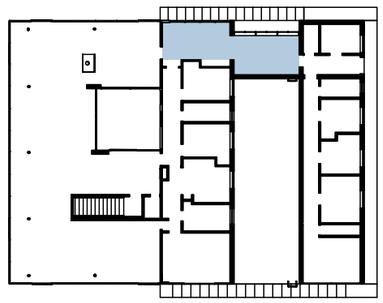


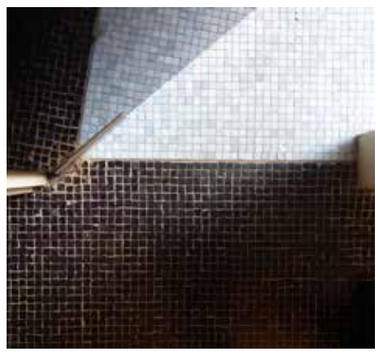
Blocks of white peroba (*paratecoma peroba)*

Code	Component
Wall CV.03.01.03	Finishing on internal walls plastered and painted
Floor CV.03.02.02	Ceramic flooring



Code	Component
Wall CV.03.01.04	Finishing of 15 x 15-cm smooth white tiles
Floor CV.03.02.01	Vidrotil tile flooring

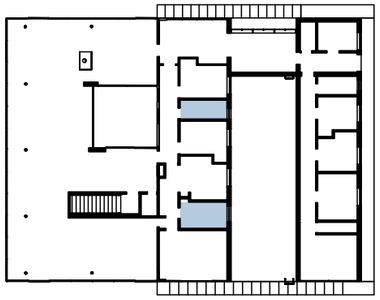




Section of floor where the azure Vidrotil tiles of the living room meet the black tiles of the pantry

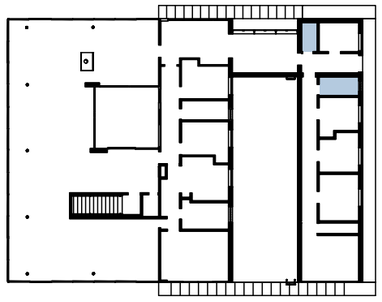
Finishing of 15 x 15-cm smooth white tiles

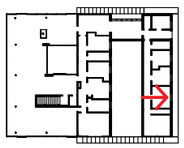
Code	Component
Wall CV.03.01.05	Walls finished with Vidrotil tiles.
Floor CV.03.02.01	Vidrotil tile flooring

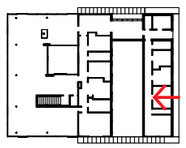


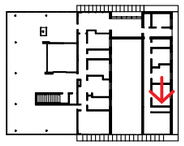
Master bathroom and
half bath with flooring
and walls finished
with Vidrotil

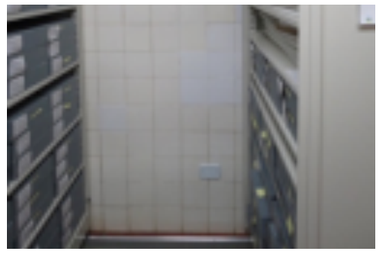
Code	Component
Wall CV.03.01.04	Finishing of 15 x 15-cm smooth white tiles
Floor CV.03.02.02	Ceramic flooring

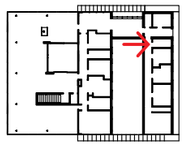


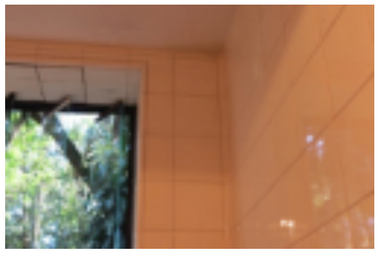


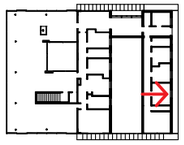


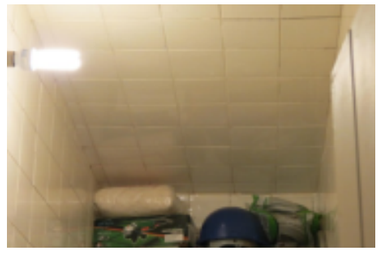


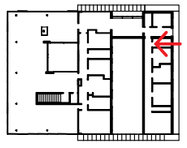












Tile finishing, also
including the ceiling

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.02.05	external walkway	Concrete flooring on the staircases and external walkways around the house.	Undermining and erosion of the land between the house and the sidewalk that cause cracks that increase infiltration and moisture in the walls. The spontaneous vegetation that appears in these cracks contributes to the entrance of rainwater and facilitates the accumulation of moisture underground and in the baseboards of the walls.	Undermining is a consequence of runoff from the soil.	Correct the points of undermining by removing the concrete flagstones, once again refilling the base and replacing the flagstones. It is necessary to distance the concrete flagstones from the walls in order to allow external drainage to take place around the entire perimeter of the residence. Drainage will decrease moisture and bring facilitated evaporation to the foundation as a result of the material employed in the subsystem. Previous attempts to rejoint the gaps failed. Should the drainage have an effect and the undermining be stemmed, the joints should be redone using mortar with additives that cause expansion and waterproofing.

Concrete flooring on the staircases and external walkways

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.03.01	finishing on the ground slab underside (*soffit*)	Smooth plaster finishing on the underside of the ground slab in the pilotis area. The slab is made of reinforced mortar. The finishing has ledges on the lateral extremities, functioning as a sill.	Efflorescence, fissures, detachment of the plaster finishing and peeling paint.	This area is susceptible to such pathologies due to the moisture in the atmosphere.	Removal of loose material and reconstitution of the mortar, with posterior painting with lime. Maintenance should be executed every 10 years.

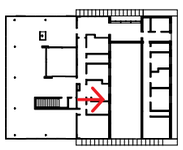
Situation reached in 2006 with displacement of layers of mortar at the slab's edges . Source: IB. Photo: MVB

Stains on the slab's underside viewed from the pilotis

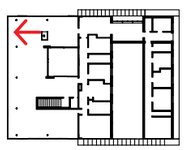
Situation of the piloti lining in 2006, with several spots of bulging and stains. Source: IB. Photo: Nelson Kon

Typical detachment of the mortar layer at the edges of the slab

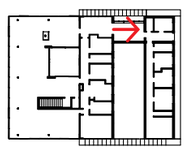
Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.03.01	finishing on the roof slab lining	The internal surfaces of the roof slab display original fine-grained mortar with sand of undetected origin.	Good state of conservation, despite infiltrations.	Appearance of moisture and fungi in areas where there are infiltrations.	Cleaning and painting after the removal of points of infiltration indicated by the roof items.



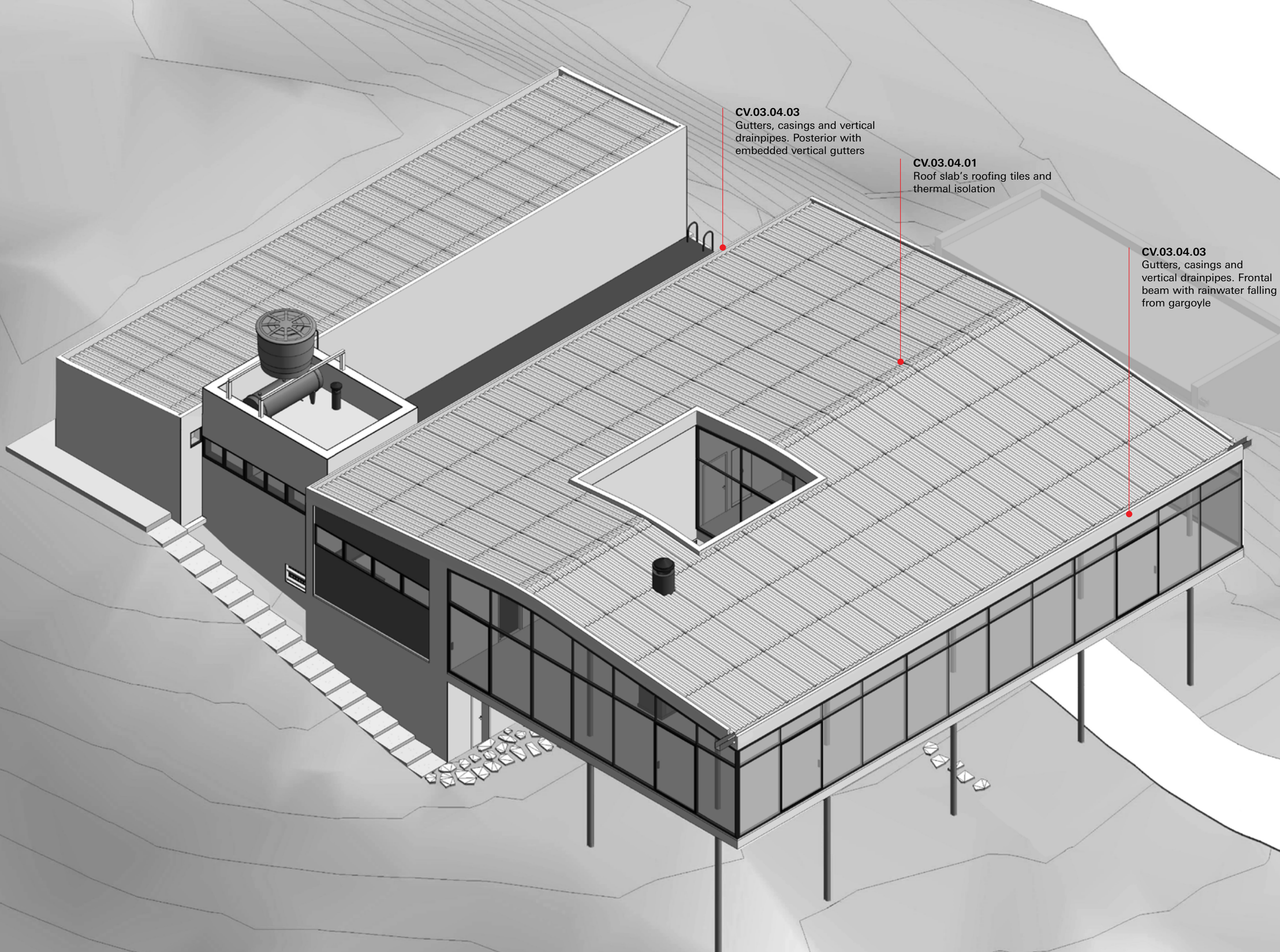
Infiltration in the vestibule ceiling resulting from clogs in the tube for falling rainwater



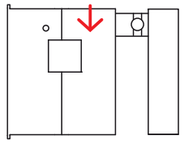
Infiltration in the living room ceiling resulting from the faulty connection between the gargoyle and the concrete gutter beam



Infiltration in the kitchen ceiling resulting from the failing waterproofing of the roof garden slab

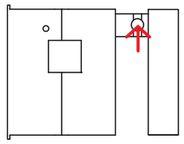

CV.03.04.03
Gutters, casings and vertical drainpipes. Posterior with embedded vertical gutters
CV.03.04.01
Roof slab's roofing tiles and thermal isolation
CV.03.04.03
Gutters, casings and vertical drainpipes. Frontal beam with rainwater falling from gargoyle

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.04.01	roof slab's roofing tiles and thermal isolation	Roof made of corrugated tiles of asbestos cement screwed to metallic clips attached to the roof's inverted beams. Thermal isolation with blankets of glass wool placed directly upon the slab.	Roofing tiles in good state of conservation, with only some broken tiles and wear and tear on thermal insulator.	Tiles of asbestos cement with asbestos in the composition. The layer of thermal isolation between the slab and the tiles is worn. Some of the screws that serve to fasten are missing and there is detachment of tiles from the rooftop causing infiltrations.	The roof is the most fragile part of the house. It is recommended that it be completely redone, the slab cleaned and the tiles, casings and gutters replaced. Complete replacement of all asbestos tiles due to their toxic characteristics. Removal of glass wool and cleaning of upper part of the slab throughout the roof's entire extension. The recommendation is to use next-generation fiber-cement roofing tiles, with no asbestos, which contain layers of thermal protection with technology of multifunctional layer (pigmentation of external layer of fiber-cement with white cement and titanium dioxide, also white), 8 mm thick.

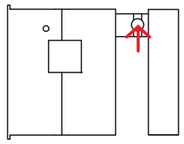


Asbestos cement roofing tile removed for inspection. Notice the load-bearing beams and glass wool for thermal insulation are worn and scattered about the slab, mixing with dried leaves.

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.04.02	rooftop garden above the kitchen	Waterproof slab with drainage into loose stones, covered with soil, where the vegetation grows.	Hydraulic installations were added to the rooftop garden which were not foreseen by the original project-- a water tank, boiler and support structure, which caused interferences. Two chimneys that release exhaust from the stove cut through the slab. The one in the corner is deactivated and shows signs of moisture infiltration and the invasion of plant roots. The other, located above the functioning stove's range hood, is covered by an electric exhauster	The rooftop garden's distinct characteristics were muddled with the installation of the water tank. The opening in the old chimney from the stove became a point of infiltration with the appearance of fungi on the roof slab in the kitchen and the area of the corner cupboard.	Removal of water tank, the metallic structure that supports it, the boiler and the pipes, with the objective of reconstituting the garden on top of the roof, associated with the design of new hydraulic installations. Redo waterproofing in order to prevent the infiltration of rainwater in the kitchen's internal area. The use of the same system is recommended for all rooftop garden slabs (see Garage, Studio and Caretaker's House). The protrusion over the old opening of the range hood duct should be newly waterproofed.

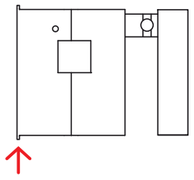


Rooftop garden over the kitchen. PVC water tank, boiler and external piping (CV.04.02) installed in 1989 to replace the original system. Though they function well, the installations had made a strong aesthetic impact on the architecture

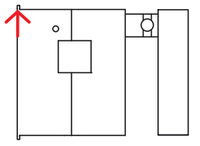


Rooftop garden over the kitchen: Original Mandacarú and survey of the layer of soil on the roof slab

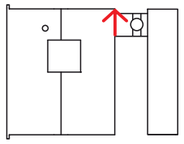
Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.04.03	gutters, casings and vertical drainpipes	Concrete gutters molded in situ in overhang covering beneath the tread of water falling from the roof; casings along the entire perimeter. In the roof's posterior planes (axises 4 and 6), rainwater flows down in tubes embedded in the masonry. In front (axis 1), the water pours down through a gargoyle of galvanized sheet metal attached to the red painted concrete gutter. Rainwater also reaches on the ground in other ways. The front gutter at the corner of axises A and 1 pours water in a free fall onto the ground covered with shavings of pink Paulista sandstone. At the corner of axises E and 1, the rainwater is poured into an open reservoir denominated as vasca ("bath" in Italian). The water from the gutter above the bedrooms and bathrooms runs down in embedded vertical tubes that empty into inspection boxes in the elevated garden. The water from the gutter in the laundry/ cleaning area runs down in vertical embedded tubes, but it is poured out onto the external sidewalk. Drainpipes run through the platband beams to aid in the draining of the rainwater from the gutters situated at the posterior axises. The detail conceived for the original slab had the roof tiles fitting into the platbands, which gave way to the casings. The current metal casings were installed as part of the roof's renovation in 1981.	There are leaks in the system of gutters and casings, resulting in infiltration, drips and moisture in the lining of the rooftop slab.	The front gutter is set atop the waterproof concrete, resulting in a spot of constant infiltration. In the two lines of posterior gutters, the tubes that empty the rainwater have nothing to protect against the entrance of leaves, giving way to clogs and diminishing drainage capacity. The casings are in good condition.	Internally refinish the gutters with an auto-adhesive aluminized asphaltic sheet in roll, in order to cover the encasement of the gargoyle in the frontal gutter and expand the slab's waterproofed area in the proximities of the posterior gutters. Install semi-spherical cast iron covers on the drain holes of the vertical tubes for rainwater. The gutters should be cleaned periodically, mainly during periods of heavy leaf fall. The casings should be periodically maintenanced and checked to identify any ruptures.



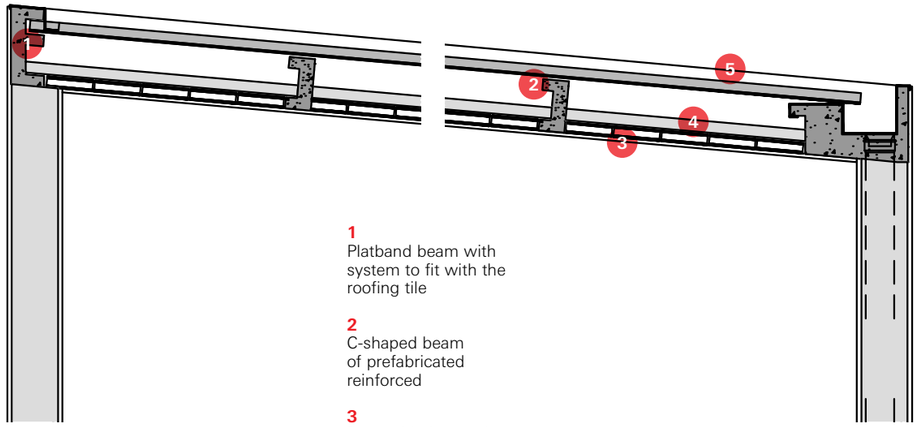
Casings covering the lateral and frontal platband beam for protection



The front gutter is set atop the concrete.



Casings covering the lateral platband beam along the entire perimeter



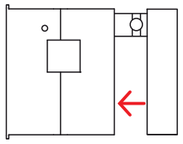
1
Platband beam with system to fit with the roofing tile

2
C-shaped beam of prefabricated reinforced

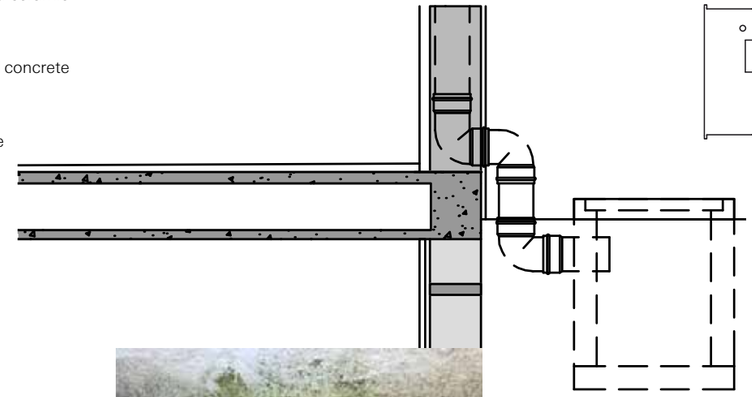
3
Pre-molded ceramic flagstone

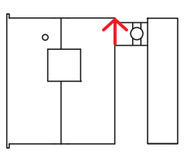
4
Reinforced concrete covering

5
Roofing tile

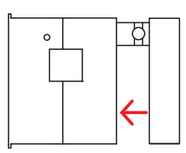


Posterior concrete gutter beam. Drain hole of the embedded vertical gutter. Notice the interference of the external hydraulic installation.

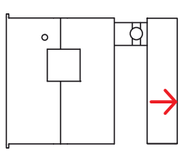




The posterior gutter's drainpipe



Inspection box of outflowing rainwater on the garden patio. Notice the presence of leaves that have flowed down through the duct.



Drainpipe exit that empties directly onto the sidewalk from the vertical rainwater gutter in the laundry/ service area

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.04.04	building exhaust systems	The half bathroom exhaust fan.	Due to its location, the half bathroom does not have natural ventilation. As such, ventilation is handled by a ceiling exhaust vent which protrudes on the rooftop above. The chimney for this exhaust vent is protected by a casing at the point where it intersects with the tiles and covered by a “Chinese hat” cover to prevent rainwater from falling in.		Periodic inspections of the casings are recommended, as well as verifications as to whether the “Chinese hat” does not obstruct the opening.

Chimney for the half bath’s exhaust vent and ventilation terminal for the sewage.

Chimney for the half bath’s exhaust vent, with “Chinese hat” removed for inspection

Internal view of the half bath exhaust vent.

CV.03.04.05	ventilation caps	Ventilation caps for the sewage system.	Located at the top of the bathroom walls, the ventilation caps for the sewage system are in a good state of conservation. There are no points of infiltration, despite the fact that the sealing casings are quite old.		Periodic inspections of the casings are recommended.

Caps on sewage ventilation tubes protected by ample collar to prevent infiltration. In the back, view of the cold water pipes installed in the platband’s internal facade.

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.04.06	deactivated kitchen chimney	Deactivated kitchen chimney covered with a slab of reinforced concrete.	The deactivated kitchen chimney suffered from rainwater infiltration and the invasion of roots from the rooftop garden.	Sealing is not sufficient to impede the invasion of roots and moisture.	Remove the cover on top of the chimney. Remove the soil from the rooftop garden in the vicinity of the chimney's facades. Redo the mechanical protection and waterproofing. Reinstall the soil and the green roof.

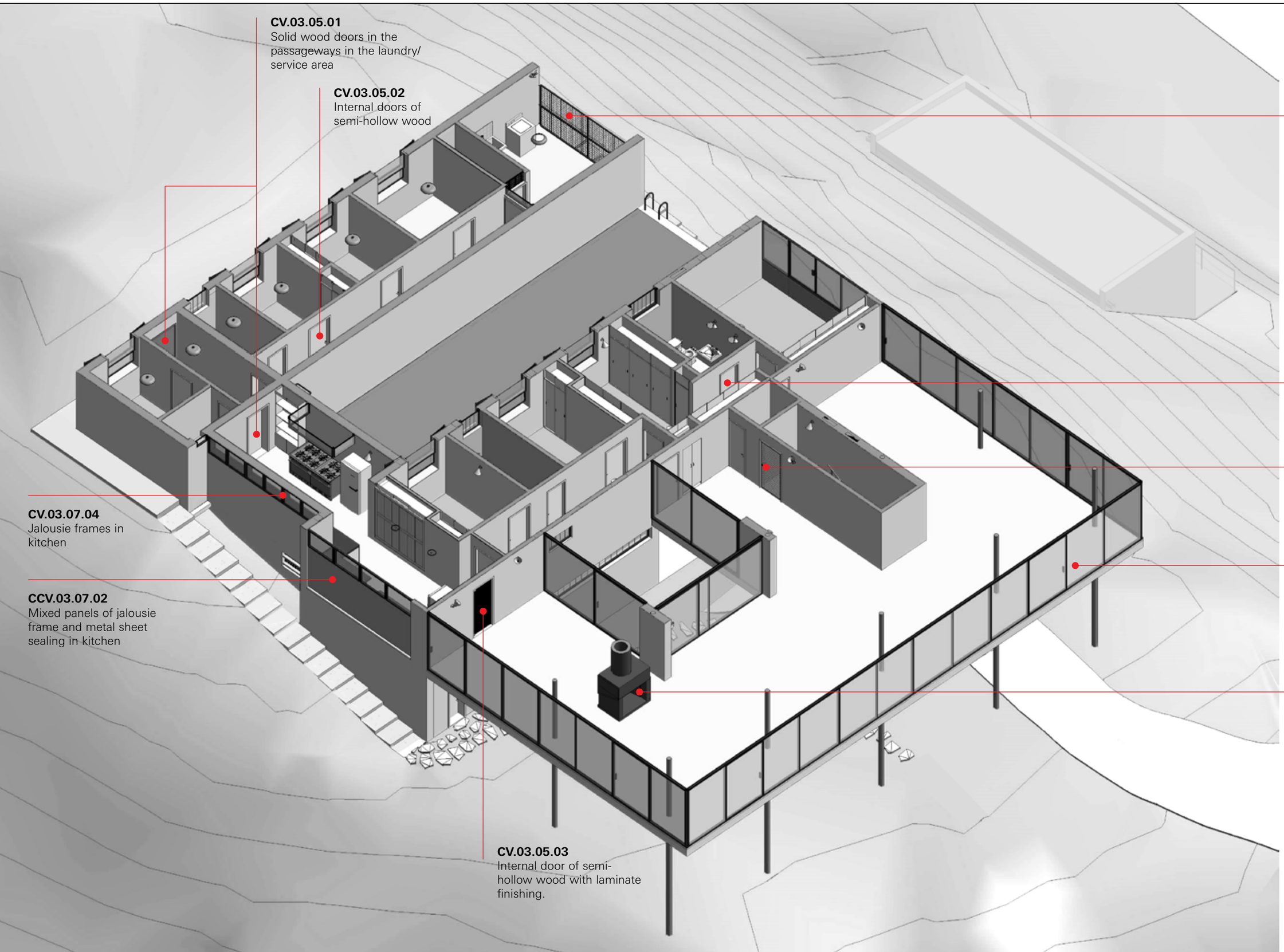
Deactivated kitchen chimney. Makeshift lid.

Invasion of plant roots

CV.03.04.07	working kitchen chimney	Working kitchen chimney	The chimney for the kitchen exhaust system is in good condition, with no points of infiltration in its vicinity.		Conduct regular maintenance, observe for the appearance of water infiltration.

CV.03.04.08	fireplace chimney	Fireplace chimney pokes through the roof over the main room. It is endowed with a protective collar that is sufficient to prevent infiltrations.	The fireplace chimney is in good condition, with no points of infiltration.		conduct regular maintenance, observe for the appearance of any water infiltration.


Ventilation caps for the sewage system
Posterior with embedded vertical gutters
External hydraulic pipes
The half bathroom exhaust fan
Ventilation caps for the sewage system
Casings covering the platband



CV.03.05.01
Solid wood doors in the passageways in the laundry/ service area

CV.03.05.02
Internal doors of semi-hollow wood

CV.03.07.04
Jalousie frames in kitchen

CCV.03.07.02
Mixed panels of jalousie frame and metal sheet sealing in kitchen

CV.03.05.03
Internal door of semi-hollow wood with laminate finishing.

CV.03.07.07
Wire screen in the laundry / service area

CV.03.05.02
Internal doors of semi-hollow wood

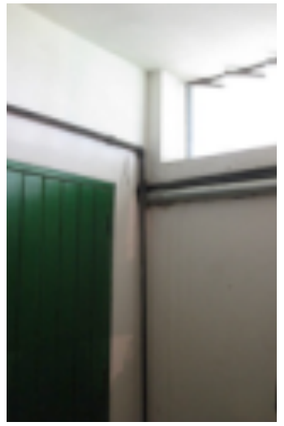
CV.03.07.08
Main entrance metal door frame.

CV.03.07.01
Fixed frames and moving (sliding) frames with glass panel, from floor to ceiling

CV.03.09.01
Fireplace and (internal) chimney

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.05.01	Solid wood doors in the passageways in the laundry/service area	Mexican-style doors of solid wood with juxtaposed boards. The two internal doors, positioned in the laundry/service corridor, are painted white. The external door is painted green (color 348 M, Pantone system), with permanent ventilation grid in artistic wavy screen.	Damaged doors with fissures and cracks. Doorknobs function poorly.		Scrape, sand and paint manually, paste over (paste of sawdust and glue). Repaint with synthetic enamel in the original color. Conduct a thorough inspection, repairing doorknobs and locks.

Solid wood doors in the passageways in the service area

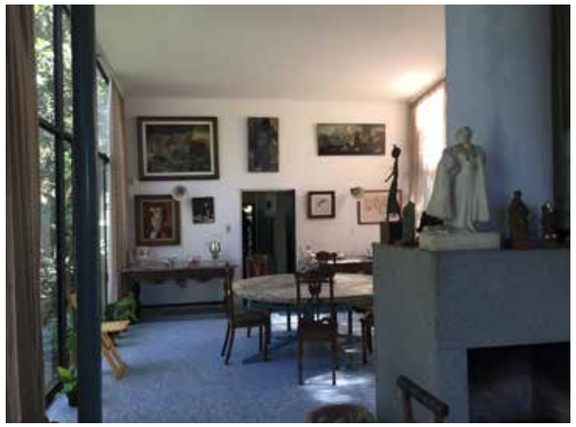


CV.03.05.02	internal doors of semi-hollow wood	Solid peroba wood door jambs with no trimming, with indent detail to conceal any cracks in the wall's plaster. Corner exposed in the plastic with embedded metal L-shaped cross section. Semi-hollow boards with solid wood frames and plywood surfaces painted in synthetic enamel. Locks with direct keyholes and no plate covers and cast bronze door handles with rosettes, designed by Lina Bo Bardi.	Damaged doors with fissures and cracks. Door handles function poorly.	The fissures in the doors may result from the excessive drying out of the atmosphere from the use of a dehumidifier.	Scrape, sand and paint manually, paste over (paste of sawdust and glue). Repaint with synthetic enamel in original color. Some doors can be replaced. Conduct a thorough inspection, repairing door handles and locks. Control use of the dehumidifier.

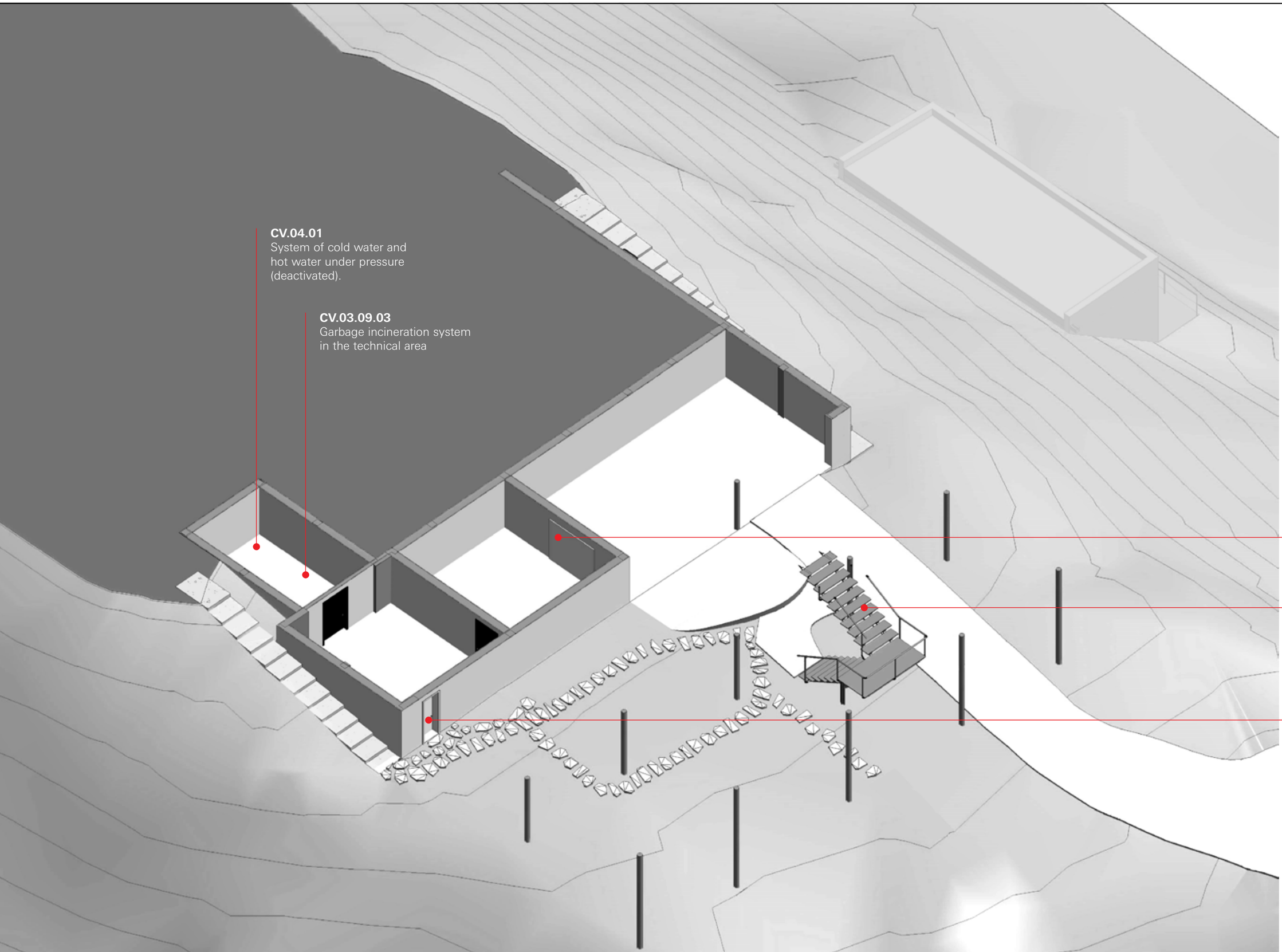
Internal doors of semi-hollow wood

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.05.03	internal door of semi-hollow wood with laminate finishing.	Solid peroba wood jambs with no trimming and semi-hollow board with solid wood frame and plywood facades finished with melamine laminate of black formica. Ordinary pull handles on cupboard doors and drawers and not on passageway doors. Doors open both directions, coming or going.	The door only opens one way, from kitchen toward living room, not surpassing the jamb when opening from room-to-kitchen.	Dislodging in the hinge.	Adjust hunge and regularly clean the laminate.

Internal door of semi-hollow wood with laminate finishing.



CV.03.05.04	solid wood sliding doors in the technical area	Mexican-style solid wood sliding doors in juxtaposed boards.	Damaged door with fissures and cracks.		Scrape, sand and paint manually, paste over (paste of sawdust and glue). Repaint with synthetic enamel in the original color. Conduct a general inspection, fixing door handles and locks.



CV.04.01
System of cold water and hot water under pressure (deactivated).

CV.03.09.03
Garbage incineration system in the technical area

CV.03.05.04
Solid wood sliding doors in the technical area

CV.03.06.01
Main staircase

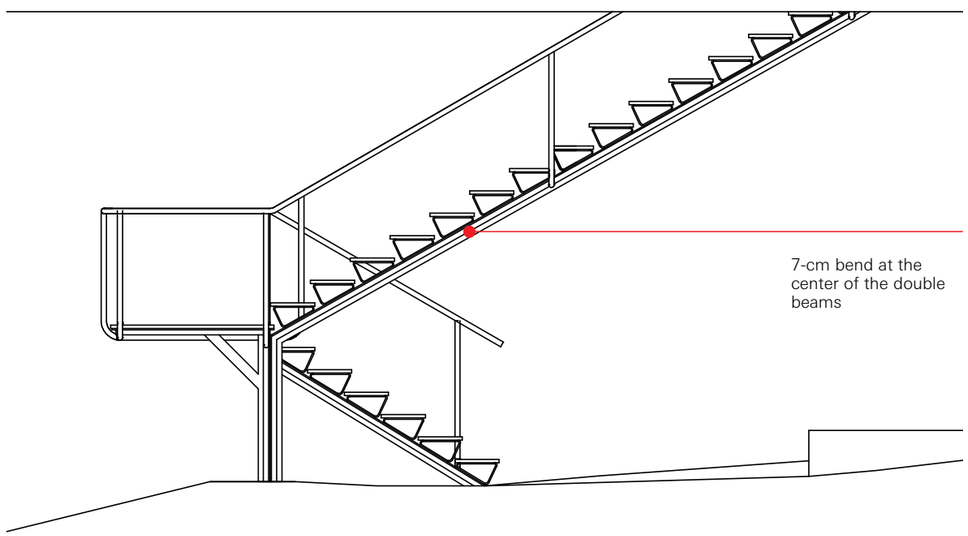
CV.03.05.01
Solid wood doors in the passageways in the technical area

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.06.01	main staircase	Two staircase sections, in asymmetrical U-shape and overlook landing. Structure of composite metal, assembled out of rivets, supported on small pillars of the same profile atop a special foundation of reinforced concrete footing. The upper part is supported on the beam of the ground slab. Treads in slabs of gray granite, with open risers on the structure.	Sparse points of oxidation. Laser survey identified a 7-cm bend at the center of the double metal beams in the larger section.		Cleaning, chemical removal of the oxidized particulars and manual scraping of the paint. Paint over with antioxidant base and epoxy paint in the original color. For the time being, do nothing to alter the structure, but accompany the development of the bend in the larger beams, informing the specialized engineer if necessary.

Staircase reaching the ground

Detail of the rivets and sheet of granite on the landing

Load-bearing metal posts set into the concrete footing



7-cm bend at the center of the double beams

View from below of the landing fitting with the structure

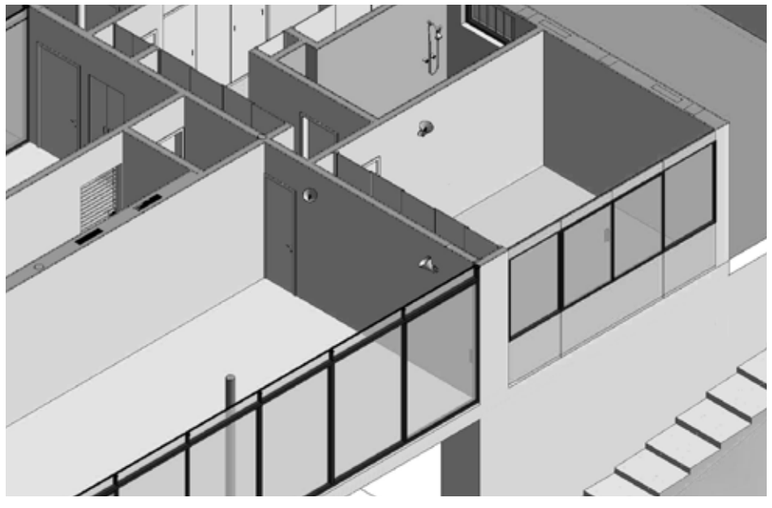
Granite landing supported on the structure by metal bracket

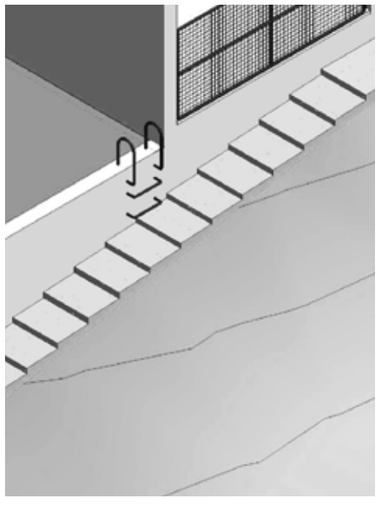
General view

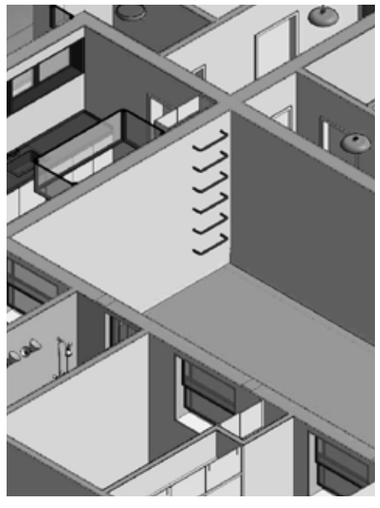
Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.06.02	boat boarding ladders 1 and 2	Metal boat boarding ladder. The rungs are cylindrical steel bars set directly into the masonry, with no joining bar between them. Handle/railing on the upper part with metal bar identical to the rungs.	Well conserved		Verify if there is oxidation or displacement of the setting in the masonry. In the event of oxidation, clean, chemically remove the oxidized particles and manually scrape the paint. Paint over with antioxidant base and epoxy paint in the original color. In the event of displacement, remove and reset into the masonry.

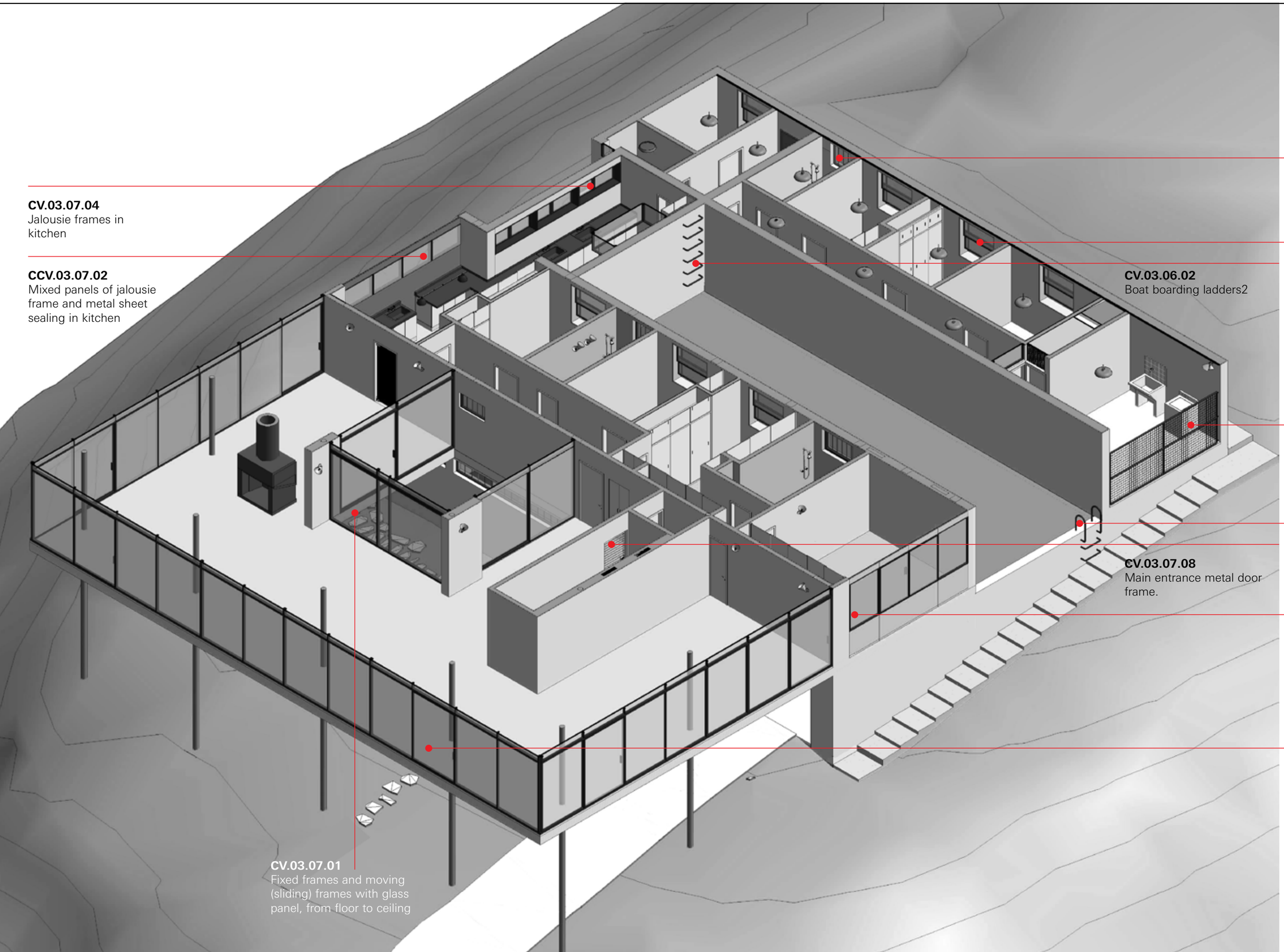
Boat boarding ladders 1

Boat boarding ladders 2









CV.03.07.04
Jalousie frames in kitchen

CCV.03.07.02
Mixed panels of jalousie frame and metal sheet sealing in kitchen

CV.03.07.01
Fixed frames and moving (sliding) frames with glass panel, from floor to ceiling

CV.03.06.02
Boat boarding ladders2

CV.03.07.08
Main entrance metal door frame.

CV.03.07.05
Jalousie frames in the bathrooms, corridor and technical area

CV.03.07.06
Guillotine frame with counterweight and Venetian shutters

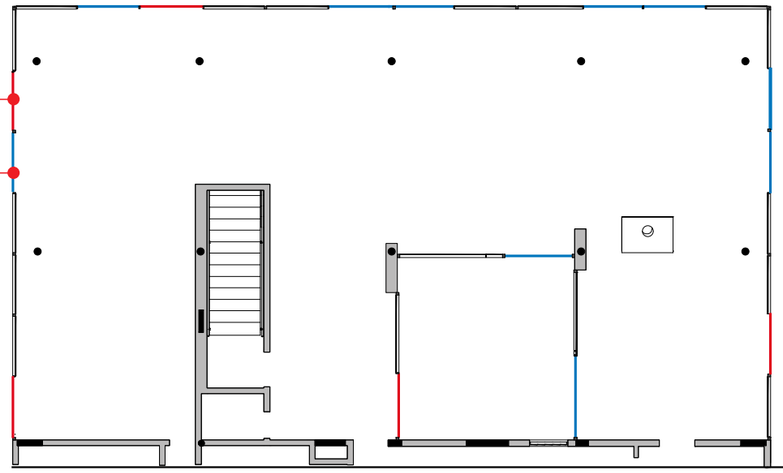
CV.03.07.07
Wire screen in the laundry / service area

CV.03.06.02
Boat boarding ladders 1

CV.03.07.03
Combined sliding and sealed metal sheet casement in master bedroom

CV.03.07.01
Fixed frames and moving (sliding) frames with glass panel, from floor to ceiling

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.07.01	Fixed casements and moving (sliding) casements with glass panel from floor to ceiling	Fixed and sliding frames with steel profiles encasing 8-mm glass windows, with the use of metal tracks and putty. Rolling bearings and accessories for movement.	The windows have broken frequently since the house was first built. The entirely open nature of the casements, with no parapets for protection, presents a risk of accidental falls and compromises the safety of users. 10 movable sheets were soldered to the volumes and their “trucks” were removed	Horizontal dilation of the roof slab relative to the ground slab causes shearing force, which is then transmitted to the glass due to the absence of elastomer in the casement and between the casement and the concrete slabs. Oxidation of the tracks, casement and other components. Expansion of the oxidized material corresponding to up to ten times its volume by the iron hydroxide, which contributes to the compression of the glass. Impact of tree branches from the garden. Casements identified as lacking support, pulley and other elements that impede functioning and opening. Glass material damaged. The current glass, 5 mm thick and not the original type, was most likely imported and polished. In 1962, Casa Conrado substituted all of the glass, 8 mm thick and not very resistant to impact, in addition to not protecting from sun rays. Subsequent exchanges utilized plain 8-mm glass and tempered 10-mm glass.	Two stages are required: the substitution of the glass for a laminated, more resistant model, and the placement of elastomer between the glass and the casement. Should the glass continue to break, it will be necessary to remove all the casements and lay in a thin film of polyurethane to separate the casement from the reinforced concrete of the roof slab. Oxidation: general cleaning of the casements, which should be scraped and painted with a primer base for metal structures and epoxy paint. Replacement of damaged parts and application “sacrificial” zinc tiles to minimizing the corrosion of the actual metal of the casement. Glass: substitute with planibel clearlite glass, comprised of two 4-mm sheets, involving a clear PVB sunnergy film, produced by the manufacturer AGC. In addition to mechanical protection, this glass offers 91% transparency and 89% protection against ultraviolet rays, allowing for the curtains to be opened without compromising the integrity of the institute’s collection. Fall prevention: install component to limit the opening in the casement to a maximum of 15 cm.



View of the casements closed

View of the casement half-opened

Pin as device serving to block the opening

“Truck” for movement in the casements

Orientations

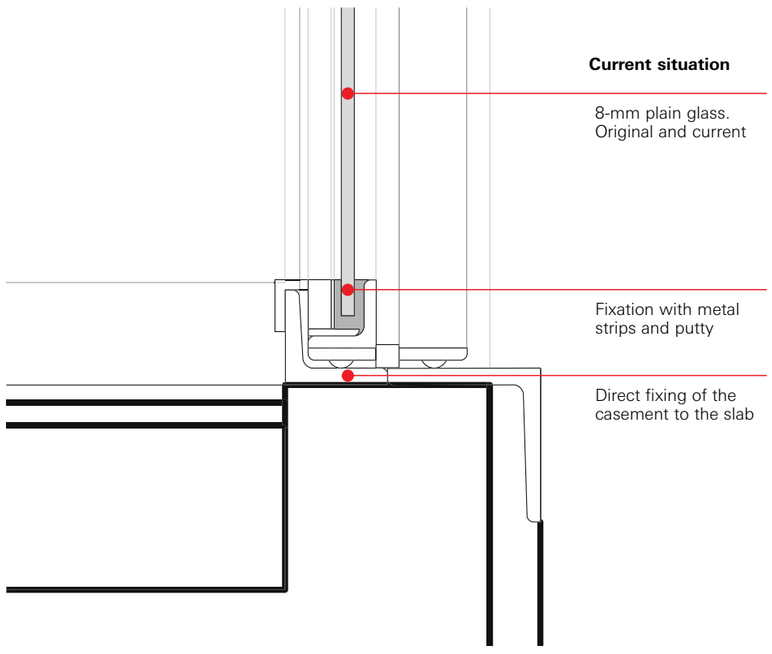
CV.03.07.01

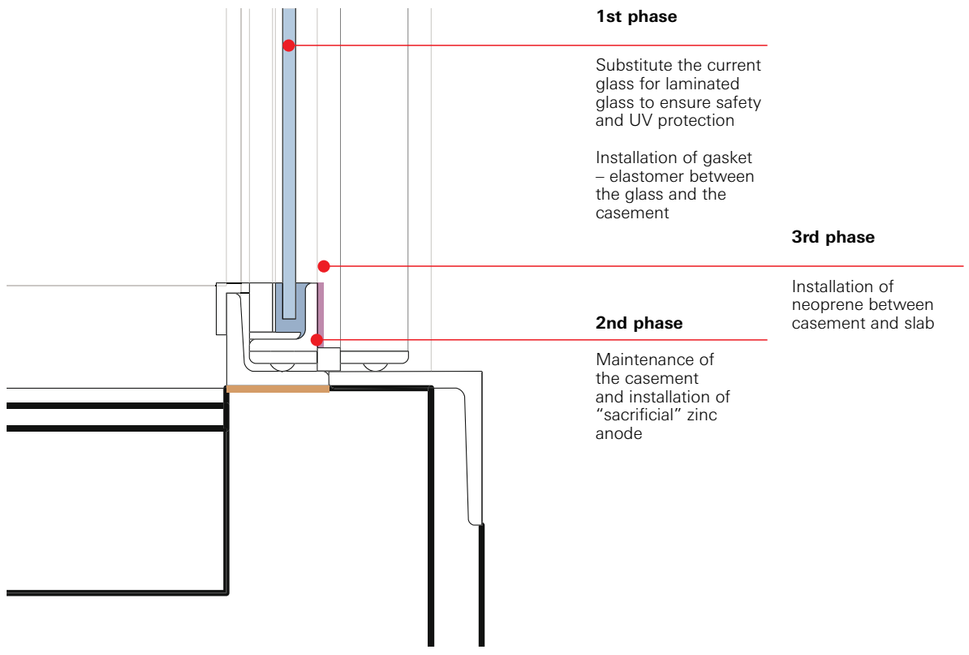
Two stages are required: the substitution of the glass for a laminated, more resistant model, and the placement of elastomer between the glass and the casement.
Should the glass continue to break, it will be necessary to remove all the casements and lay in a thin film of polyurethane to separate the casement from the reinforced concrete of the roof slab.

Oxidation
General cleaning of the casements, which should be scraped and painted with a primer base for metal structures and epoxy paint. Replacement of damaged parts and application "sacrificial" zinc tiles anodo to minimizing the corrosion of the actual metal of the casement.

Glass
Substitute with planibel clearlite glass, comprised of two 4-mm sheets, involving a clear PVB sunnergy film, produced by the manufacturer AGC. In addition to mechanical protection, this glass offers 91% transparency and 89% protection against ultraviolet rays, allowing for the curtains to be opened without compromising the integrity of the institute's collection.

Fall prevention
Install component to limit the opening in the casement to a maximum of 15 cm.





Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.07.02	Mixed panels of jalousie frame and metal sheet sealing in kitchen	Panels from floor to ceiling comprised of metal profiles, sealed by double sheets, on the inside and the outside with internal glass wool insulation. The sealing sheets are painted red (color 200 M, Pantone system) on the external facade and green (color 348 M, Pantone system) on the internal facade. Steel windows in the kitchen with chair rails encasing glass, asymmetrical bascule activated by chain, roll-forming jambs.	General good state of conservation with occasional oxidation in the boards and jambs. Glass material damaged.		Cleaning, chemical removal of the oxidized particles and manual scraping of the painting. Repaint with antioxidant base and epoxy paint in the original color.

External view of the kitchen and main room windows

Combined panel casement, kitchen interior

Combined panel, kitchen interior. Bascule pull.

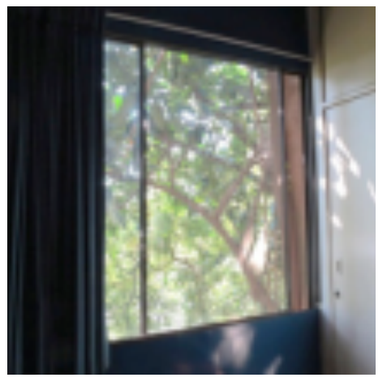
CV.03.07.03	Combined sliding and sealed metal sheet casement in master bedroom	Panels from floor to ceiling comprised of metallic profiles, sealed with double sheets, on the inside and outside, with internal isolation in glass wool. The sealing sheets are painted red (color 200 M, Pantone system) on the external facade and blue (2945 M, Pantone system) on the internal facade. The volumes form sliding frames with rollers below the sheet.	General good state of conservation with occasional oxidation in the sheets and jambs. Glass material damaged. Casement oxidized and in poor working conditions.		Cleaning, chemical removal of oxidized particles and manual scraping of the paint. Repaint with antioxidant base and epoxy paint in the original color.

External view

Internal view

Window track and locking system

Internal view of window



Meeting corner of wood block floor, metal panel and masonry wall. Oxidation onset.

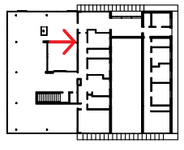
Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.07.04	Jalousie frames in kitchen	Steel kitchen windows with chair rails encasing glass, chain-activated asymmetrical bascule, roll-forming jambs set into masonry finished with tiles.	General good state of conservation with occasional oxidation in the sheets and jambs. Glass material damaged.		Cleaning, chemical removal of oxidized particles and manual scraping of the painting. Repaint with antioxidant base and epoxy paint in the original color.

External view of jalousie frames in kitchen

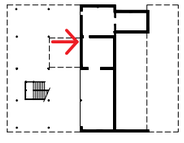
Jalousie frames in kitchen. Bascule pull.

Internal view of jalousie frames in kitchen

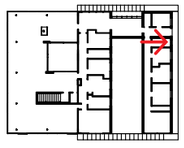
CV.03.07.05	jalousie frames in the bathrooms, corridor and technical area	Vertical windows with no frame, structured in U profiles in horizontal facades, with pivoting movement activated by lever on the lower rod.	Oxidized frames functioning poorly.		Cleaning, chemical removal of oxidized particles and manual scraping of the paint. Repaint with antioxidant base and epoxy paint in the original color. Recuperation of the pivots' movement.



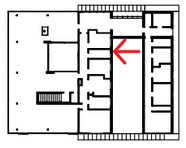
Jalousie frames in the technical area and corridor



Jalousie frames in the service bathrooms



jalousie frames in the social bathrooms.

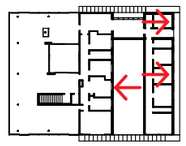


jalousie frames on the bathroom

Detail of the opening mechanism and fixation of the glass

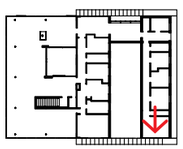
Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.07.06	guillotine frame with counterweight and Venetian shutters	Metal L profiles encasing glass with moving shutters with counterweight interconnected by steel cable and pulleys, set shutter in the upper section. “U” profile jambs on the lateral (guillotine tracks) and upper sides, and inverted U below the windowsill. Double-plated Venetian shutters in frame with chair rails.	General good state of conservation with occasional oxidation in the shutters and jambs. Guillotines and counterweights also in good condition.		Cleaning, chemical removal of oxidized particles and manual scraping of the painting. Repaint with antioxidant base and epoxy paint in the original color.

Internal view of bedroom guillotine frame

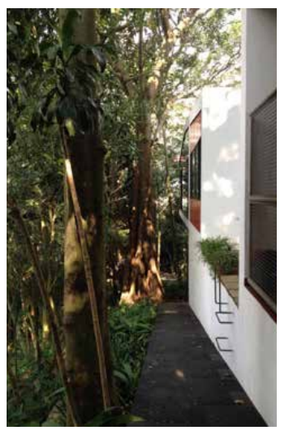


Backyard view of guillotine frame, Venetian shutters and solid wood doors

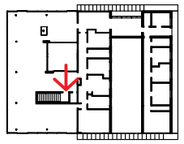
CV.03.07.07	wire screen in the laundry / service area	Frame of tubes and artistic, waved metal screen facade, with 4 x 4 mm netting and 14 wire painted in aluminized paint.	Little oxidation in the metallic screen and peeling of aluminized paint.		Chemical cleaning and manual scraping of paint, application of anticorrosive primer. Paint over in aluminum paint.



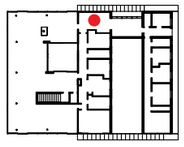
Wire screen in the service area



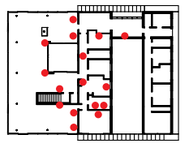
Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.07.08	Main entrance metal door frame.	L-profile door, encasing glass and horizontal, internal steel bars, with no pull or doorknob, the ironwork consists of simple lock with latch and hinges.	General good state of conservation with occasional oxidation in the door and jamb.		Cleaning, chemical removal of oxidized particles and manual scraping of the paint. Repaint with antioxidant base and epoxy paint in the original color.

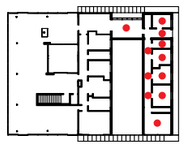
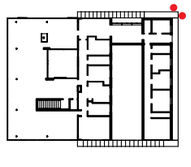


Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.08.01	Composite kitchen lights	Composite lights hanging from same pendant and oriented for direct and indirect lighting in the pantry.	Good state of conservation.		Regular cleaning.



CV.03.08.02	simple indirect light	Industrial spotlight on the wall, activated by joints or flexible hinge.	Good state of conservation.		Regular cleaning.



Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.08.03	Column light	Industrial spotlight supported on a metallic tube column with a pyramid base. Designed by André Vainer.	Good state of conservation.		Regular cleaning
					
CV.03.08.04	Industrial style hanging light with reflector	Industrial style lights with silver reflector hanging rigidly in conduits or flexible PP cables (cables with two layers of PVC).	Good state of conservation.		Regular cleaning.
					
CV.03.08.05	External lighting	Wall lights with industrial style reflector for outdoor illumination.	Good state of conservation.		Regular cleaning.
					

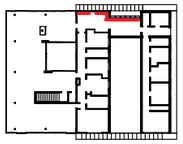
Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.09.01	fireplace and (internal) chimney	Fireplace box constructed out of brickwork, finished on the outside with granite and on the inside with refracting bricks. Chimney finished with mortar, intentionally stained with lime paint, like a fresco.	No pathologies identified.		Regular cleaning.

CV.03.09.02	range hood in kitchen	Frames with sheets of glass form three faces of a parallelepiped stone.	No pathologies identified.		Regular cleaning.

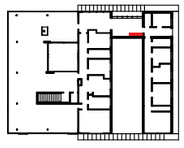
Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.09.03	kitchen garbage chute	Metal cylindrical duct that runs through the ground slab to dispense the garbage into a recipient in the technical area of the lower level, where there is an incineration system. Moving metal lid with hinge.	No pathologies identified.		Regular cleaning.

CV.03.09.04	folding table in the pantry.	Plywood table covered in a layer of green formica with subtle square-shape pattern. It is installed vertically in a frame on the wall made of the same material, but white-colored, activated two hinges that allow it to open into a horizontal position. A foldout foot consisting of a metal tube painted dark green stabilizes the table when open.	The system functions well. The side edges of the board that forms the table are damaged, likely by termites, eliminated in the maintenance of 2007-2008.		The damages on the sides do not impede the functioning of the system, but they can be corrected with a new finish.

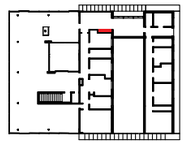
Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.09.05	cupboards below the counters in pantry and kitchen	Low cupboards in the kitchen, with drawers and cabinets with sliding doors and shelves of plywood painted in synthetic enamel. Countertops and sinks in stainless steel on the upper part.	No major pathologies identified, original pull handles.		Regular cleaning, paint when necessary.



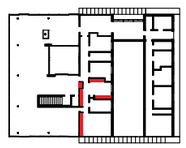
CV.03.09.06	corner cupboard in kitchen	Plywood painted in synthetic polish, curtain enclosure.	The cupboard is situated beneath the old chimney flue, which shows signs of infiltration and invasion of plant roots from the rooftop garden. Movable enclosure over the flue with sheet of styrofoam covered in plastic.		After correcting the upper part of the old chimney flue, install an enclosure with frame and metallic sheet treated with antioxidant base and epoxy paint.



Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.03.09.07	wall cupboards in the pantry and kitchen	The doors of particle wood, framed and covered in a layer of green formica, have a subtle square-shaped pattern. The original glass doors were replaced in the 1980s. The internal plywood doors covered in formica were replaced in 2007.	The doors are old, but do not present any major pathologies. Similarly, no major problems were identified in the internal part of the cupboards. Recommended replacement of the current doors with glass doors, corresponding to the images of the original cupboards. Store the removed doors because decorative laminates in this pattern and color no longer exist on the market, or maintain the lower row as a register from the period.		



CV.03.09.08	bedroom closets	Doors of plywood and solid wood painted in synthetic white enamel.	Well conserved with no apparent damage.		Regular cleaning.



Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.04.01	system of cold water and hot water under pressure (deactivated).	The house's hydraulic system was originally constructed based on a water tank and boiler situated on the lower level of the technical area. It was operated by an electric pump which maintained the water pressure in the upstairs pipes.	The system was deactivated in the 1970s due to its poor functioning. The original installations are preserved in the technical area and inside the walls.		Maintain as is, inspecting for any occasional points of moisture or infiltration.

Water tank on the ground floor in the technical area

CV.04.02	system of hot and cold water by gravity.	Installed in the 1970s to substitute the original system which had been been working poorly, it is located on the rooftop garden above the kitchen supported on a structure of steel profiles. The first water tank, of reinforced mortar, collapsed in 1989 and was replaced by the current PVC model. The boiler is attached to the system. To transport the water to the points of consumption, a new network of pipes, positioned externally to the walls and internally to the platbands and gutters.	The combination of the water tank and exposed installations have an impact on the look of the house, altering its profile. The pipes set into the platbands affect the draining of the gutters.		Design a new hydraulic network, positioning the water tank on a tower at the higher, back part of the garden. This reservoir should supply the main residence and all outbuildings (caretaker's house, studio and garage) and eliminate the existing tanks. It is necessary that the dimensions of this reservoir be large enough to adequately supply the fire fighting system in the entire garden area.

Water tank on top of the rooftop garden above the kitchen

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.04.03	septic tank	Due to the absence of a sewer system in the development, the system of domestic sewage is connected to a septic tank, situated in the lowest part of the lot, next to the present-day studio.	The characteristics of the septic tank present risks of accidents.		Maintain the cover intact and closed, and show employees where it is located, informing them of the risks of accidents.

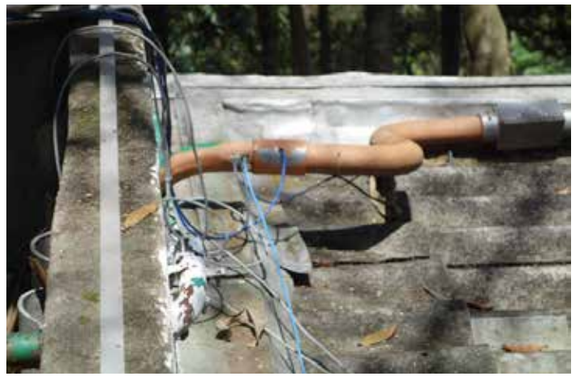
cover of the deactivated septic tank

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.05.01	SPDA – System of Protection against Atmospheric Discharges	System of protective screening, similar to the Faraday cage, installed over the casings in the platband girders. The grounding stretches down the walls.	Well conserved, it should be removed and reinstalled in the event that the casings are replaced. Verify whether it is possible to install an Individual Protection System (IPS) of set cables in the platbands-- a requirement to insure safety during the cleaning of the roof and gutters.		
CV.05.02	tubes and frames of electrical installation 2013	The renovation of electrical installations (2013) gave way to new installations with external tubes and frames	Recent installation, in good state of conservation		

New installations with external tubes for electricity, telephone and data cables

Photos of the existing wiring system before it was substituted by external tubes

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CV.05.03	cables and wires on the rooftop	Telephone and data cables are positioned at certain points on the roof. There are deactivated electrical wires in the platband of the rooftop garden above the kitchen.	The cable and wires make cleaning the roofing tiles more difficult.		Remove the deactivated wires and install the telephone and data network in specific ducts.

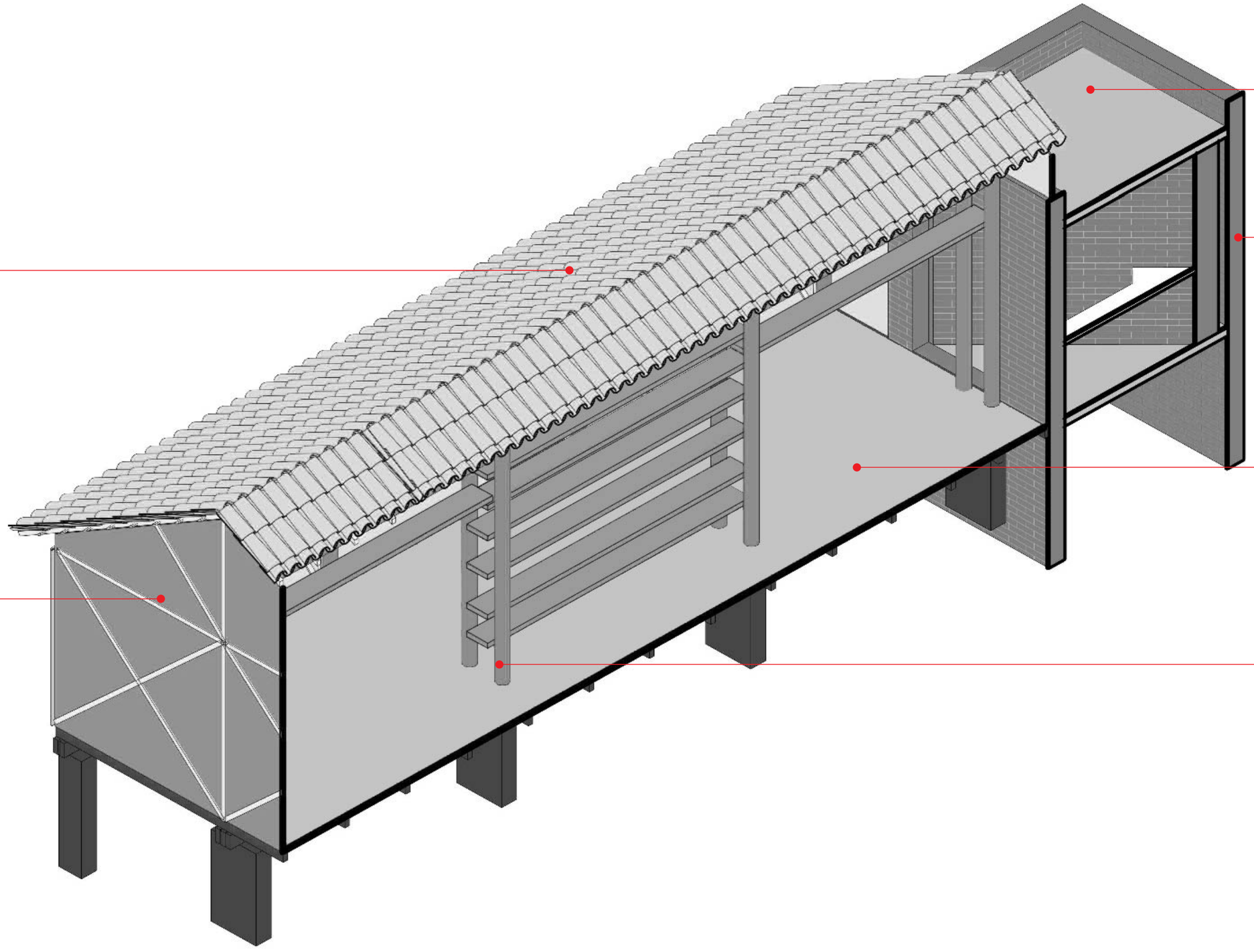


Telephone and logical system wire on the roof

CV.05.04	ground floor electrical outlets	Ground floor electrical outlets inserted into cylindrical bronze pieces embedded in the living room floor, refinished with Vidrotil.	The cover and protective plate was removed, exposing the outlets to potential accidents. The wiring and electrical outlets were substituted in the maintenance efforts of 2011 and 2012.		Recuperate the covers and reinstall them.

Electrical outlets in the living room floor.

3.4 Studio ES



ES.02.01
Roof comprised of missionary tiles made of ceramic

ES.02.04
Wood panels

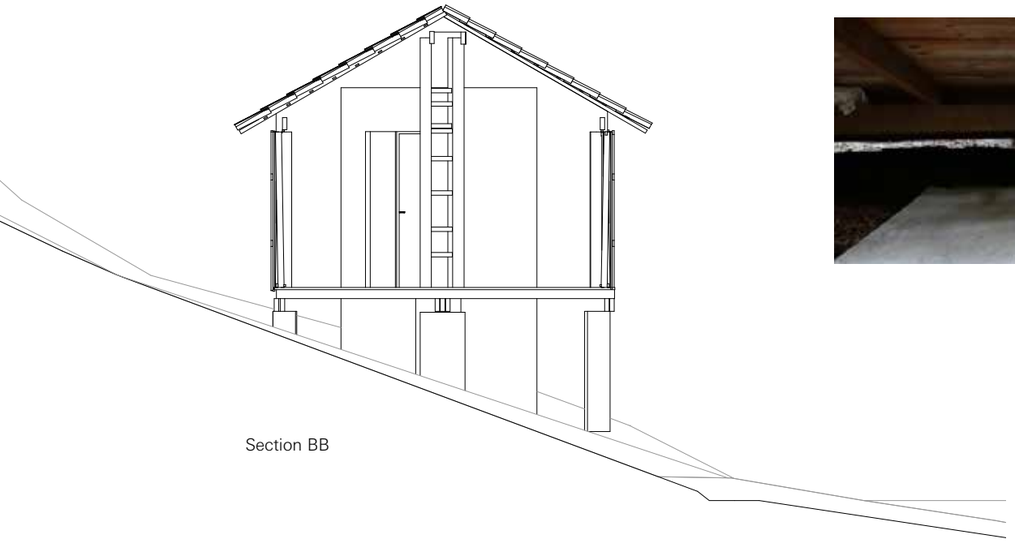
ES.01.05
Rooftop garden

ES.01.04
Hydraulic unit load-bearing masonry walls.

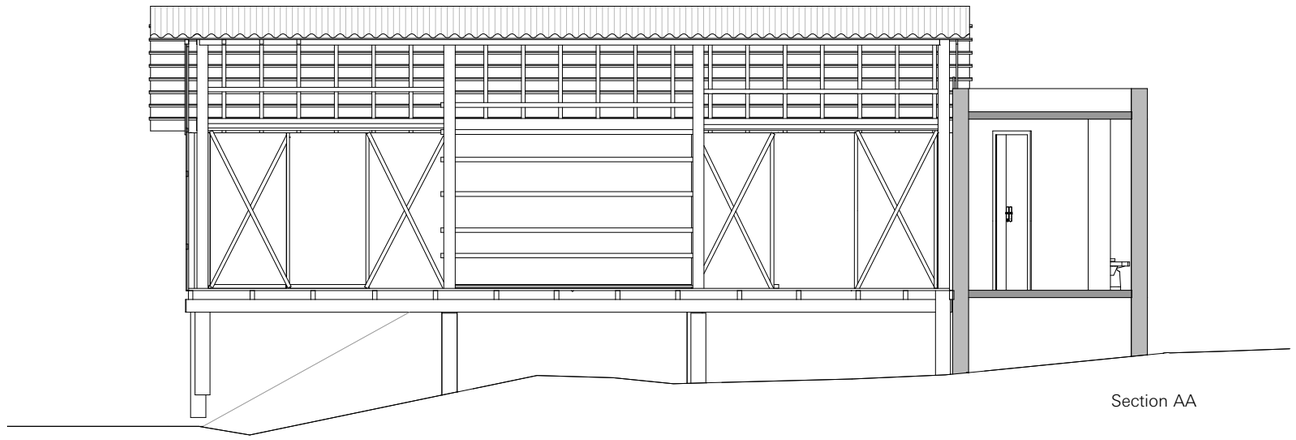
ES.01.03
Hardwood flooring

ES.01.01
Wood structure on pillars / reinforced concrete foundations.

Code	Component	Description	Diagnosis	Identified pathology	Orientations
ES.01.01	wood structure on pillars / reinforced concrete foundations.	Wooden structure supported by reinforced concrete pillars on footing with bored piles. The pillars support the 6 x 16 cm longitudinal Peroba wood beams which, in turn, support 6 x 12 cm transversal beams, also made of Peroba wood. The flooring of juxtaposed pinewood boards is supported by these transversal beams, elevating the body of the house off the ground. The concrete pillars give way to unrigged eucalyptus pillars. There are also 6 x 16 cm rafter ties and a pair of 6 x 16 cm ridge joists. 6 x 6 cm rafters supported on the joists sustain the gable roof, covered by ceramic mission tiles.	Good state of conservation.		Periodically inspect the conservation of the components.

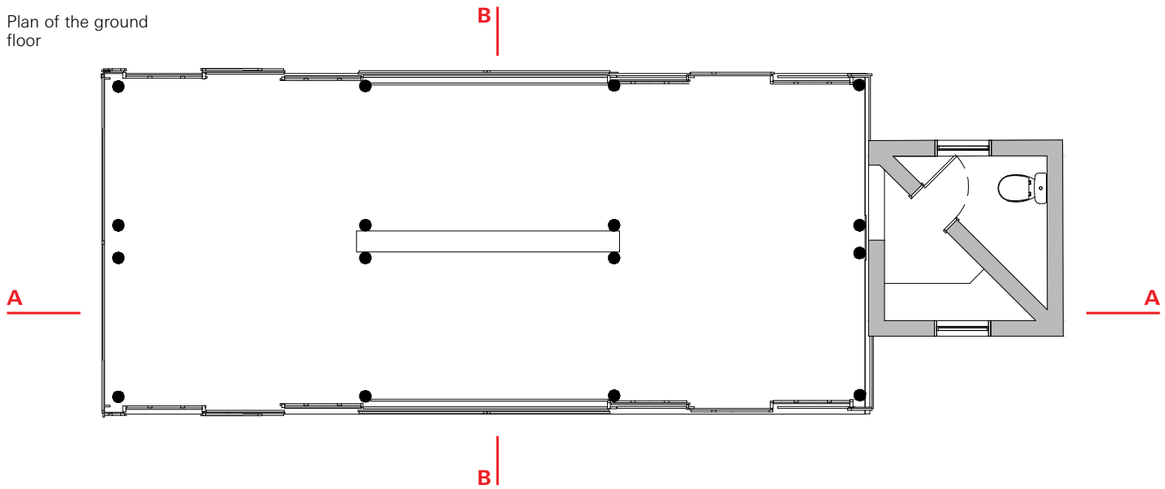


Section BB



Section AA

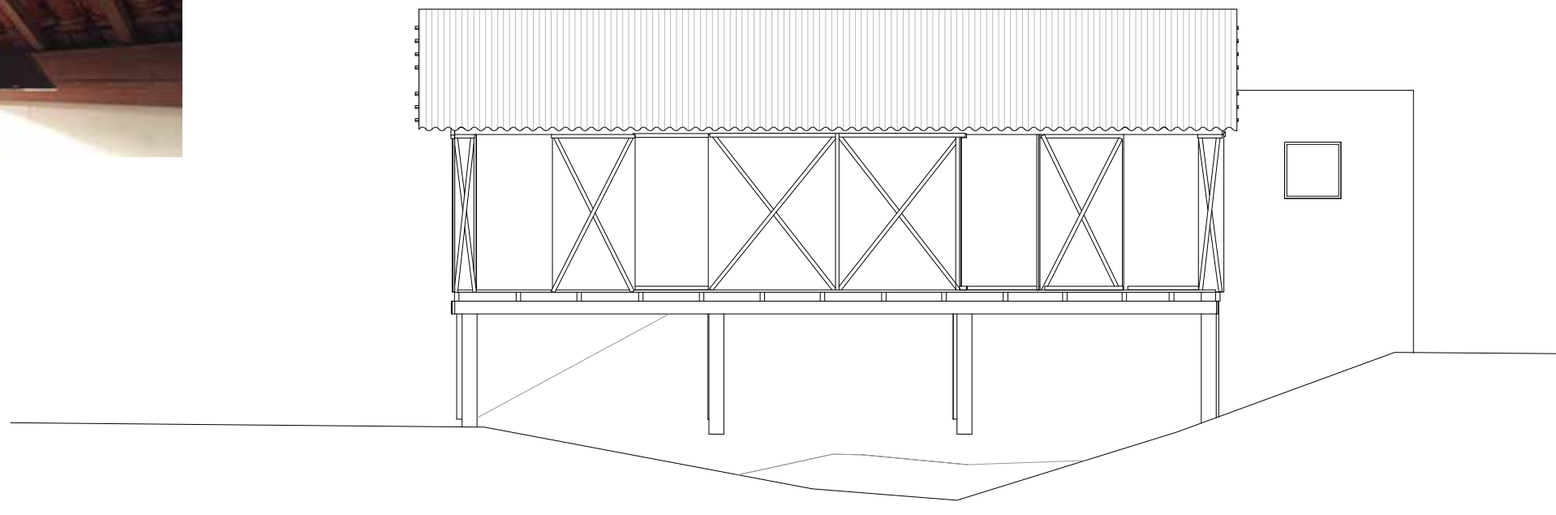
Plan of the ground floor



Code	Component	Description	Diagnosis	Identified pathology	Orientations
ES.01.02	reinforced concrete pillars	Reinforced concrete pillars on bored pile footing.	Good state of conservation, with dirt stains discovered, apparently the result of proximity to the soil.		The green stains on the pillars/ foundation blocks do not cause any damage to the structure at all. Washing them with chlorine is all that is needed to remove them.
					
ES.01.03	hardwood flooring	Pinewood floor, supported on 6 x 12 cm transversal beams of Peroba wood. There are gaps between the boards due to the absence of joints.	The wood's protective film is worn and boards are exposed. The gaps between the boards allow wind to enter causing discomfort on cold days.		The boards should be sanded and treated with wax periodically in order to maintain their natural characteristics and protect the wood. To reduce discomfort caused by the entrance of cold air, the gaps between boards should be sealed.
					
ES.01.04	hydraulic unit load-bearing masonry walls	Volume of load bearing masonry, 1 brick thick (20 cm, with no external finishing), set atop grade beam footing.	Good state of conservation, with no apparent cracks.		Periodic inspections.
					

Code	Component	Description	Diagnosis	Identified pathology	Orientations
ES.01.05	rooftop garden	Garden atop reinforced concrete slab, set on load-bearing masonry walls. Waterproofed and covered with layers of stone, sand and soil from the garden.	Well conserved slab with no points of infiltration.		Maintenance with normal cleaning and check for infiltration.

ES.02.01	roof	Roof comprised of missionary tiles made of ceramic and glass atop a conventional wood structure: joists, rafters and laths. “Free tile” with no lining on bottom side.	Tiles well conserved, with no moisture on the internal surface. Some tiles occasionally break due to falling trees and branches.		Sweep the roof clean with a broom and replace tiles whenever necessary. Stock up for future repositioning, regular maintenance.



Code	Component	Description	Diagnosis	Identified pathology	Orientations
ES.02.02	refinishing of masonry walls	Masonry walls finished in burnt cement on the inside facade and whitewashed on the exterior facade.	Excellent state of conservation. There are small whitish stains, which indicate superficial calcifications.		Wash the walls with clean water and a soft cloth to remove whitened stains.
ES.02.03	boat boarding ladder	Metal boat boarding ladder to access the hydraulic unit's rooftop garden. Flat profile, vertical structure consisting of soldered cylindrical steel bars, vertical volumes and handrail embedded in the masonry. Painted blue (2945 M, Pantone system).	Good state of conservation.		Verify if there is oxidation and any detachment where the structure is embedded in the masonry. For the oxidation, cleaning, chemical removal of the oxidized particles and manual scraping of the paint. Repaint with antioxidant base and epoxy paint in the original color. For the detachment, remove and re-embed in the masonry.

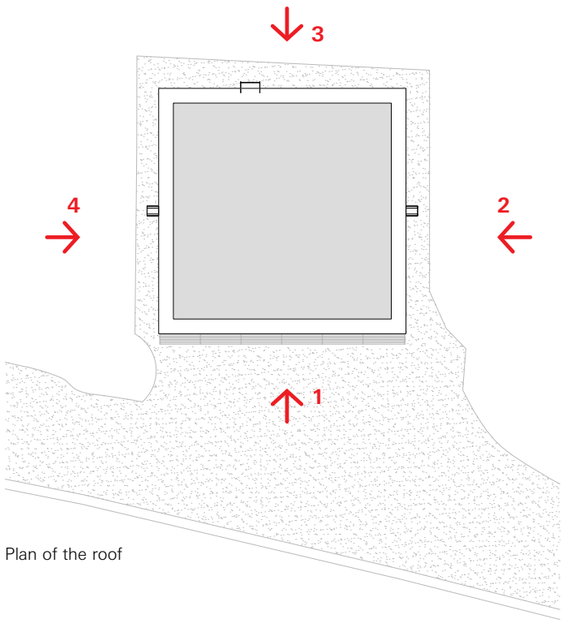
Boat boarding ladder embedded in the stonework

Masonry walls finished in burnt cement on the inside facade and whitewashed on the exterior facade.

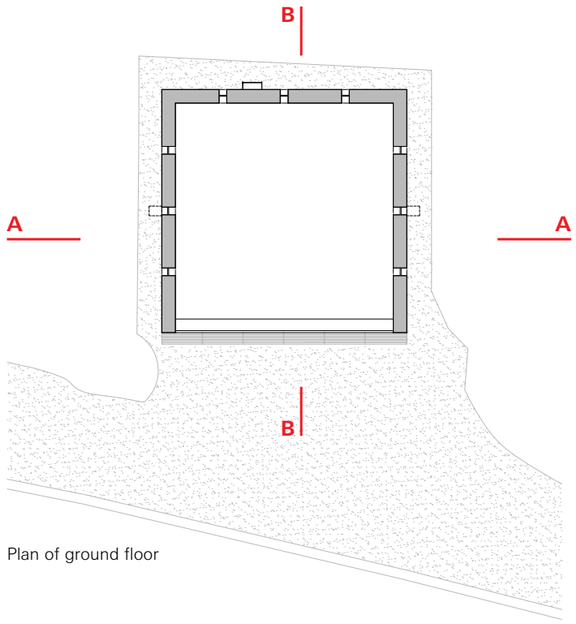
ES.02.04	wood panels	External sealing in plywood panels mounted on clapboards, from floor to ceiling, part of them sliding on tracks.	Some panels are slightly warped, compromising their movement. Natural wearing of paint.		Regular maintenance to protect the wooden elements, mandatory sanding and subsequent repainting in green paint (color 348 M, Pantone system) specifically designed for wood.

Wood panels external view

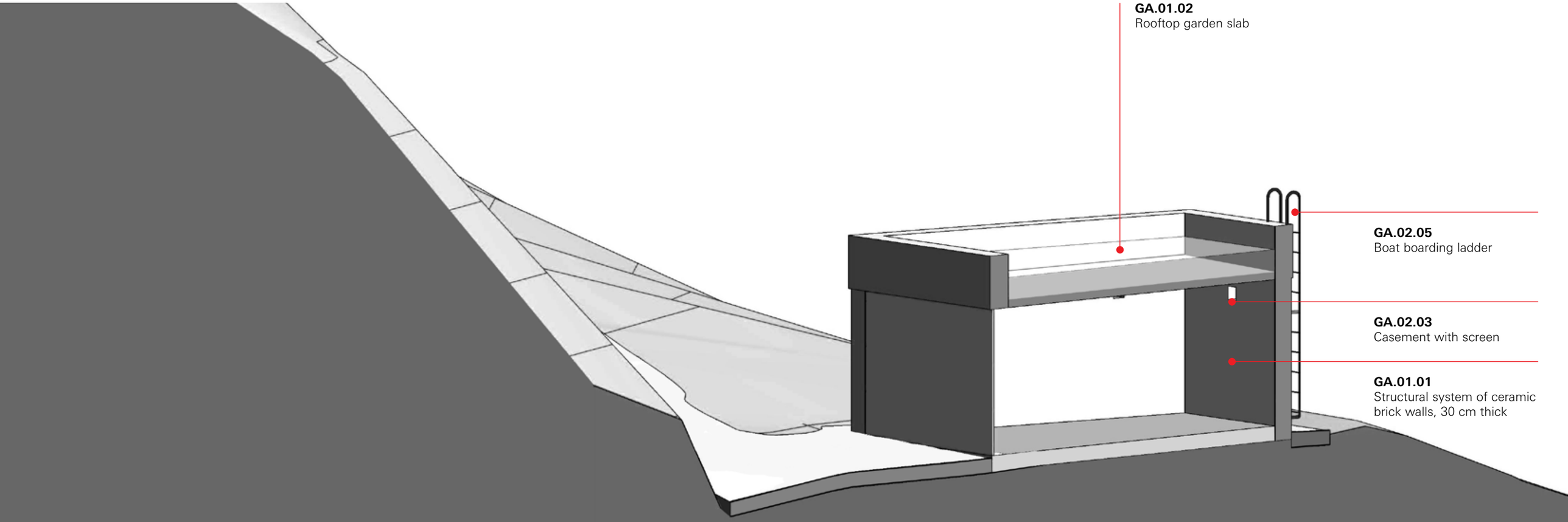
3.5 Garage
GA



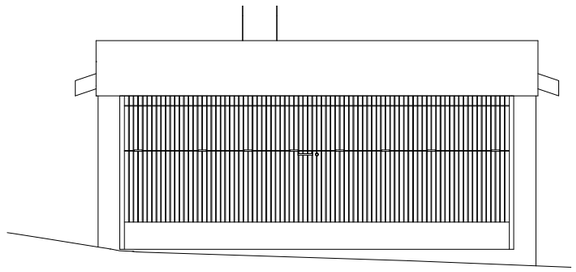
Plan of the roof



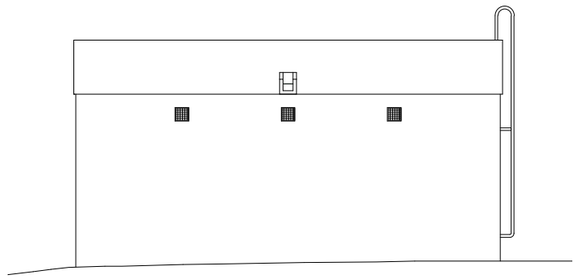
Plan of ground floor



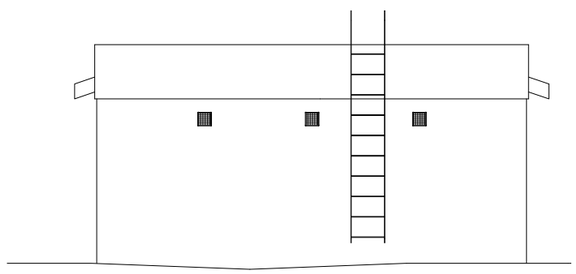
Code	Component	Description	Diagnosis	Identified pathology	Orientations
GA.01.01	structural system	Concrete slab for the roof garden supported on ceramic brick walls, 30 cm thick, erected atop shallow strip footing or slab-on-grade foundation. There is no information about the structural system in the Bardi Institute's archives. Dimensions obtained through surveying.	Cracks in the finishing of the platbands and walls, but they do not compromise the structure.		



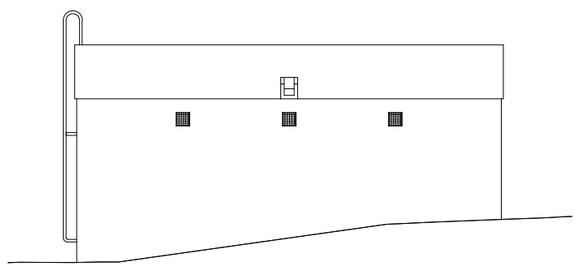
View 1



View 2



View 3



View 4

Code	Component	Description	Diagnosis	Identified pathology	Orientations
GA.01.02	rooftop garden slab	Slab covered in greenery over layers of soil, gravel and waterproof protection.	Large quantity of vegetation, including small and medium-sized trees on top of the waterproofed slab. Infiltration of water with appearance of fungi on the roof slab.	Aggression of plant roots to layer of waterproof protection.	Remove the layer of vegetation and redo the waterproof protection wherever necessary.

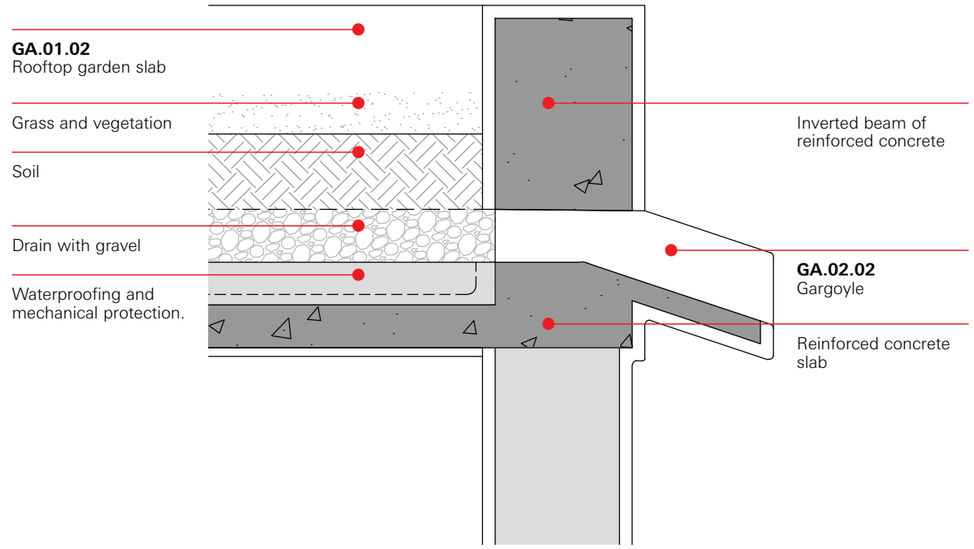
Survey of the layer of soil and gravel that precedes the layer of waterproof protection.

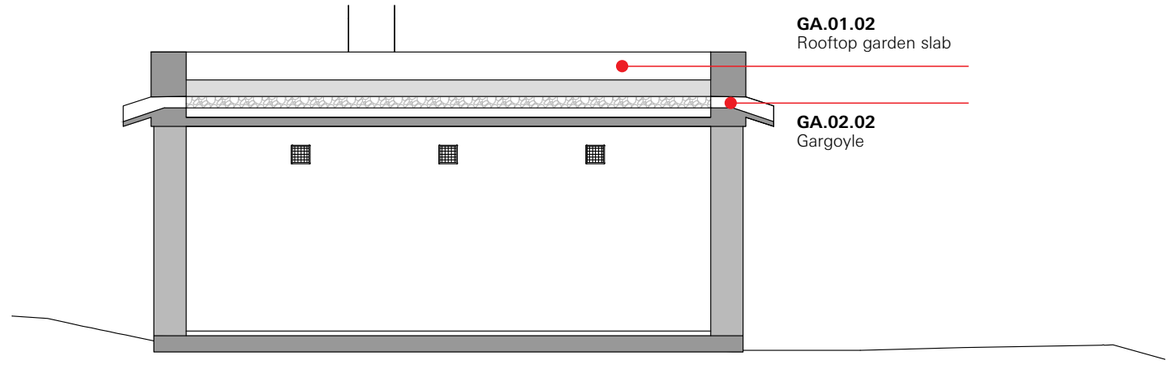
GA.01.02
Rooftop garden slab
Grass and vegetation

GA.02.02
Gargoyle

Side view of the garage. Vegetation on the rooftop slab and finishing camouflage the construction of the garden.

Large quantity of small and medium-sized vegetation on top of the waterproofed slab.





Section AA

Code	Component	Description	Diagnosis	Identified pathology	Orientations
GA.02.01.01	finishing on the lower face of the slab	Finishing of the wall plaster on the lower face of the rooftop garden slab, in roughcast, dash and smooth plaster, painted with lime.	After the recent renovation, the linings are in a good state of conservation. Before this, there were stains and cracks with detached mortar, efflorescence, fissures and peeling in the paint and refinishing.	Area susceptible to such pathologies due to the exposure to moisture in the environment and occasional infiltrations resulting from wear on the slab's waterproof protection. The fact that these pathologies have not resurged after a recent renovation which corrected the internal refinishing without intervening in the waterproof protection, reinforces the hypothesis that the cause was the moisture in the environment.	Monitor the finishing's behavior. In the event of a resurgence, remove loose material and reconstitute the mortar, subsequently painting with lime.

Situation before the renovation: Stains and detachment of the plaster finishing under the slab.

Visitor reception area installed in the garage in 2018. Note that the infiltrations in the ceiling plasterwork did not return after the cleaning and painting.

GA.02.01.02	finishing of external walls	Mortar of the external finishing with incrustations of tumbled pebbles and ceramic shards.	Cracks and bulges in certain parts of the finishing on the platbands and walls, but nothing to compromise the structure.		Strive to maintain the integrity of the original finishing as well as possible, considering the difficulty in attempting to recreate the original composition. An evaluation should be conducted regarding the option of recreating it as accurately as possible or maintaining it in its ruined state. In the platband's internal facades, where the areas with the most damage are concentrated, remove the material and recompose the finishing.

Finishing of external walls. Details

Finishing of external walls. Upper view from the platband.

Finishing of external walls, General view of the wall

Code	Component	Description	Diagnosis	Identified pathology	Orientations
GA.02.01.03	finishing on the internal walls	Walls clad in roughcast, dash and wall plaster finishing, painted with lime.	After recent renovation, the walls are in a good state of conservation. Before, there were stains and cracks with detachment of the mortar, efflorescence, fissures and peeling of the plasterwork.		Annually inspect the conditions of the plasterwork. Should the pathologies return, manually sand the mortar, wash with water and chlorine, remove the loose material and replace the missing mortar. Repaint with lime.

Finishing on the internal walls junction with the gate framework

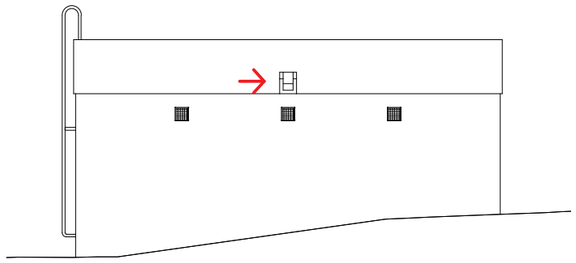
GA.02.01.04	internal floor finishing	Black ceramic flooring.	Good state of conservation, with a few broken pieces.		Leave as is.

Internal floor broken pieces junction with the metal drain grill cover

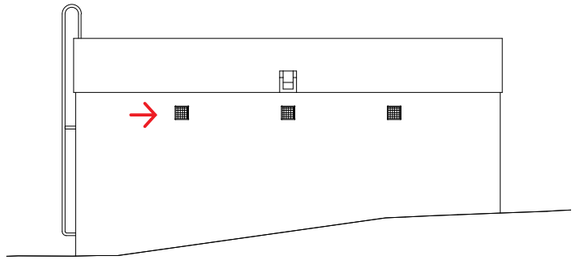
Code	Component	Description	Diagnosis	Identified pathology	Orientations
GA.02.01.05	external floor finishing	Sidewalks around the garage, with flooring in blocks of pink sandstone with mortar grouting and incrusted tumbled pebbles.	Good state of conservation.		

Lateral sidewalk in pink sandstone, with gutter in the foreground.

Code	Component	Description	Diagnosis	Identified pathology	Orientations
GA.02.02	gargoyle	Gargoyles of rainwater outflow, clad in mortar with encrusted tumbled pebbles.	Good state of conservation.		

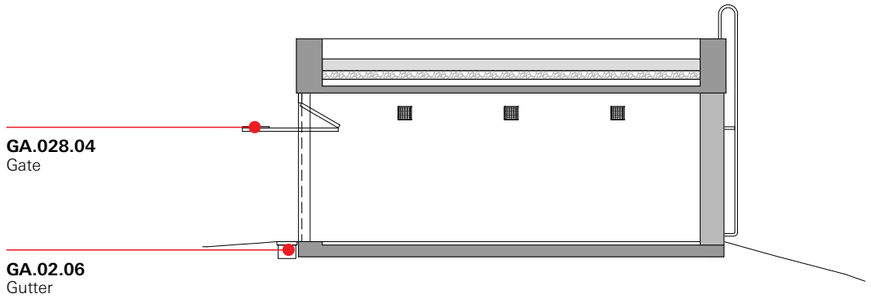


GA.02.03	Casement with screen	Metal screen fastened to metal profile casement to protect ventilation passages.	Good state of conservation.		

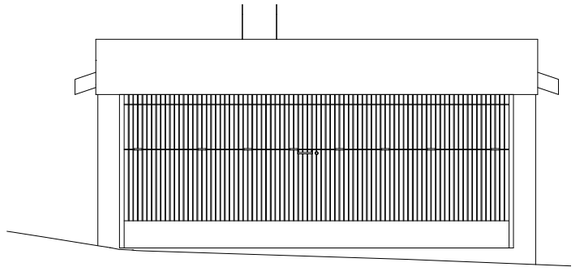


Casement with screen and finishings. Internal and external view

Code	Component	Description	Diagnosis	Identified pathology	Orientations
GA.02.04	Gate framework	Wooden gate that opens through complete vertical fold, whose movement is activated by a system of counterweights located at the back of the garage.	Oxidized hinges. Installation of additional pieces in order to seal over rotten sections in the lower part of the gate. The gate's wide span generates force at the center, which necessitated the installation of a supplementary support structure, a wire-rope type of tightened steel cable.		Substitution of the hinges with a similar model currently available on the market. Scrape the paint, fill in with sawdust and put on a final layer of plaster. Sand and repaint. Substitute the damaged wood pieces on the lower section.



Corte BB

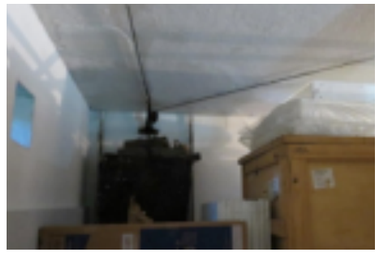


3-cm bend at the center of the gate, when opened, despite the supplementary "wagon"-style support structure.

Gate framework. Internal view, gate closed

Gate framework. Detail of the hinge between the gate's boards, highlight on the oxidation in the hinge.

Cable with counterweight mechanism



Gate's counterweight mechanism (photo before the renovation)

Code	Component	Description	Diagnosis	Identified pathology	Orientations
GA.02.05	boat boarding ladder	Metal boat boarding ladder to access the rooftop garden. Flat profile, vertical structure consisting of soldered cylindrical steel bars embedded in the masonry. Painted green (348 M, Pantone system).	There is rust in the section where the vertical structure is set into the masonry.		For the oxidation, cleaning, chemical removal of oxidized particles and manual scraping of the paint. The flat profile of the lateral structure can be entirely substituted by another, similar one. Repaint with antioxidant base and epoxy paint in the original color.

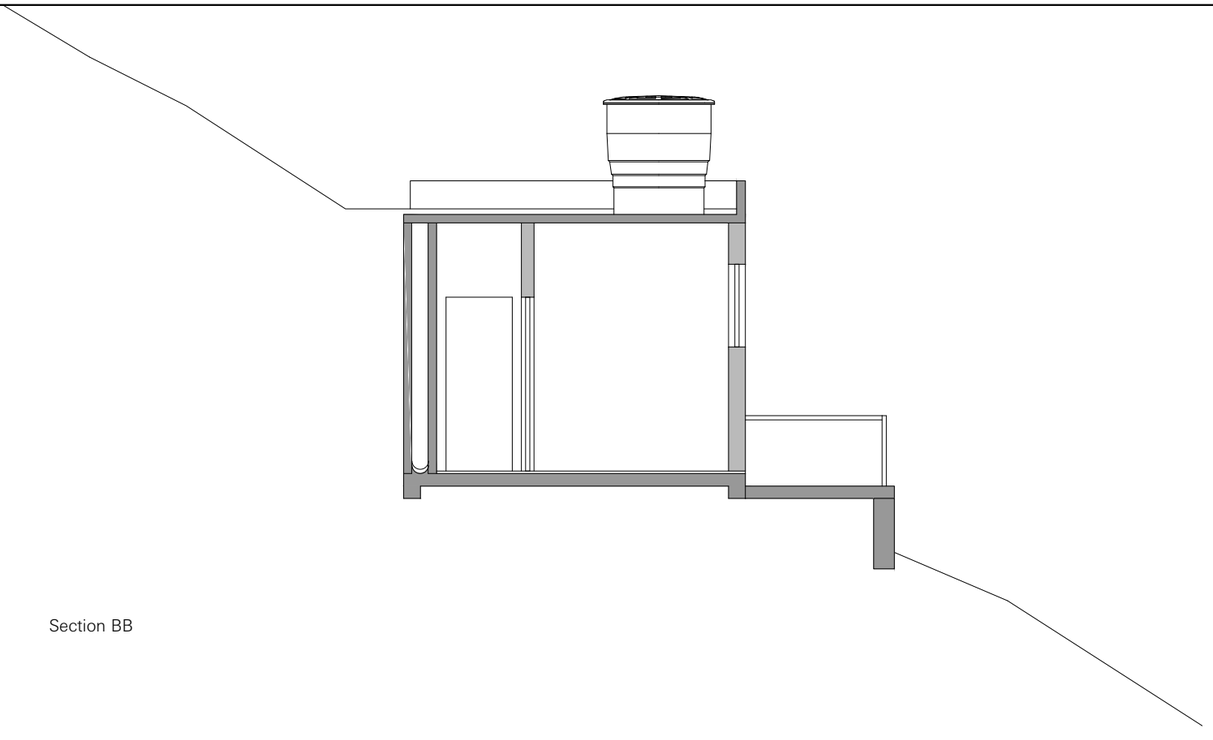
Boat boarding ladder embedded in the masonry. Inferior view

Arrival at the rooftop

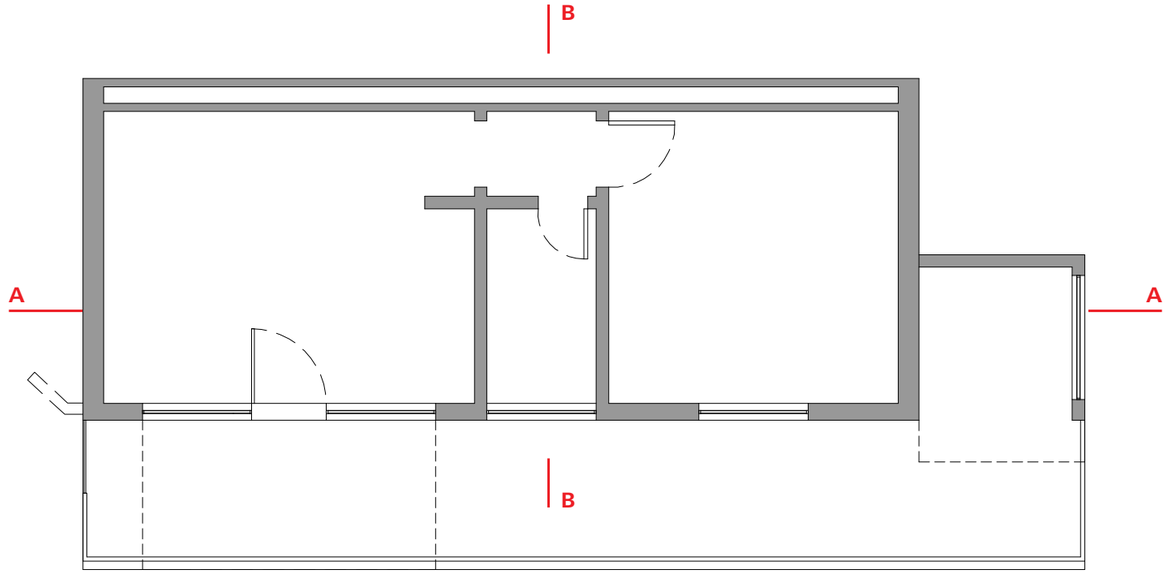
Code	Component	Description	Diagnosis	Identified pathology	Orientations
GA.02.06	gutter with metal drain grill cover	Gutter of masonry and concrete on the driveway to the garage, intending to prevent the entrance of rainwater coming from the ramp. Metal gutter, removable for cleaning. Gravity-driven outflow in the garden.	Good state of conservation and cleanliness. Some points of oxidation in the drain grill cover.		For the oxidation, cleaning, chemical removal of the oxidized particles and manual scraping of the paint. Simple cleaning of the gutter.

Gutter with metal drain cover. View with the drain open.

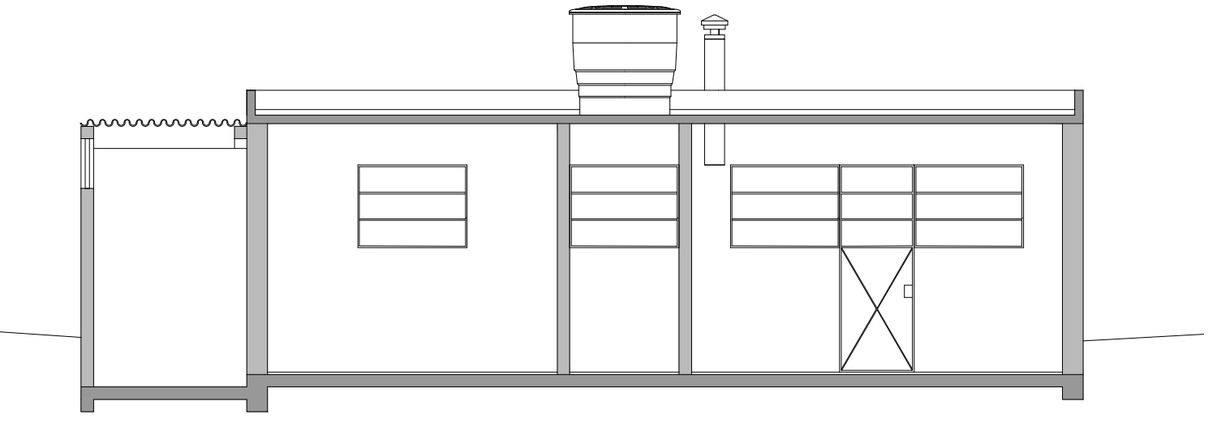
3.6 Caretaker's House CC



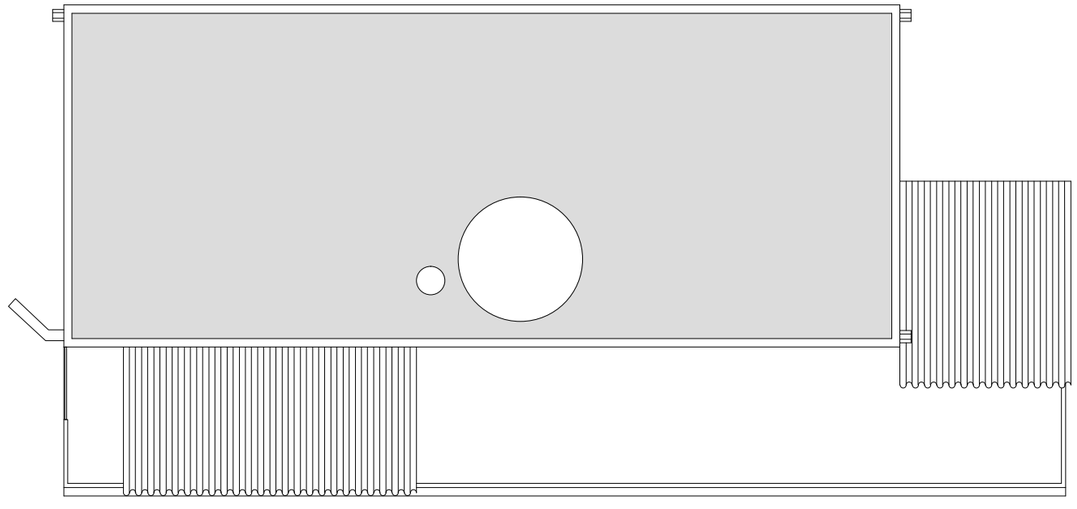
Section BB



Plan of the ground



Section AA

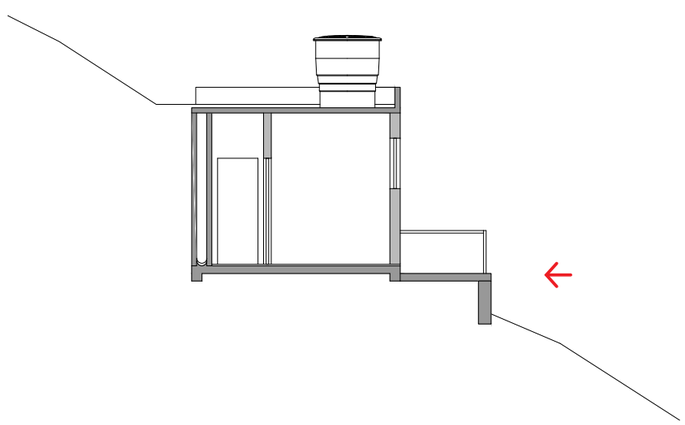


Plan of the roof

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CC.01.01	structural system	There is no information on the structural system in the Bardi Institute archives. Based on the approval drawings at City Hall and in situ inspections, it is presumed the system is constituted of a reinforced concrete slab supported on load-bearing brick masonry, with shallow strip footing or slab-on-grade foundation.			

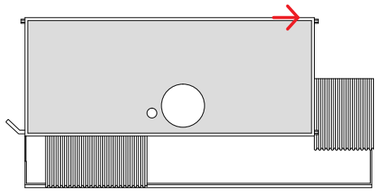
Caretaker's house viewed from the main house

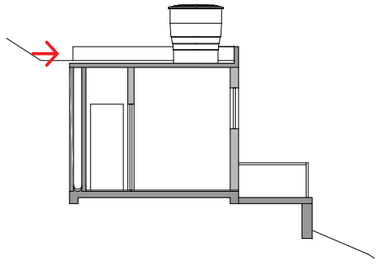
CC.01.02	external retaining wall of granite	Retaining wall made of dry-installed granite stone built according to the *opus incertum* technique (with irregularly shaped, uncut pieces). Thickness up to 80 cm in some places, with dirt and sand on the internal facade. These are the walls that structure the embankment for the ramp, the caretaker's house and the sharpest slope of the grounds next to the main house.	Good state of conservation. No apparent signs of pathology.		

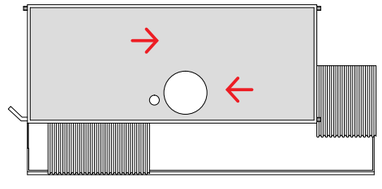


Code	Component	Description	Diagnosis	Identified pathology	Orientations
CC.01.03	rooftop garden slab	Waterproofed slab with draining and garden soil.	Infiltration of water and moisture with appearance of fungi on the slab's internal facade.	Waterproof sealing worn by roots and other interventions. Occurrence of fungi aggravated by lack of ventilation.	Redo the bottom layer in order to direct toward drains and points of rainwater outflow. New waterproof seal with layer of mechanical protection and anti-root protection. Fill in with soil with layer of gravel for draining and geo-textile screen at the exit points for rainwater outflow. Remove the water tank during the construction of a new centralized reservoir at the top of the grounds.

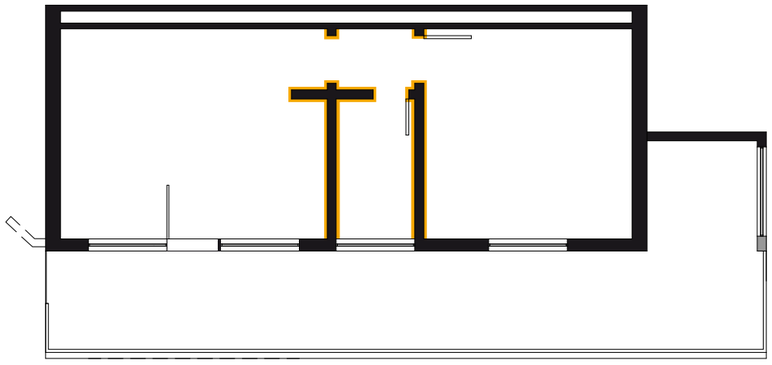
Rooftop garden. View of the slab with the soil cover partially removed to allow maintenance work on the waterproof sealing.



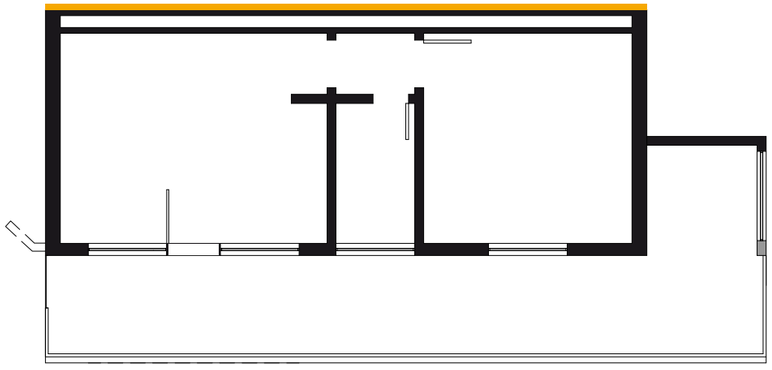




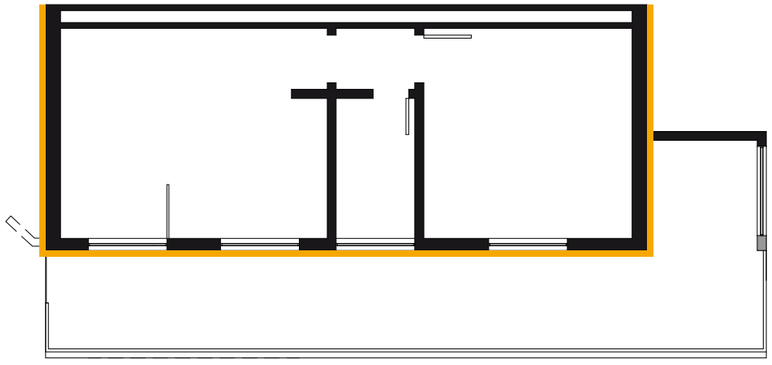
Code	Component	Description	Diagnosis	Identified pathology	Orientations
CC.02.01	Sealing internal half brick walls	Half brick walls divide the internal settings.	On the whole, well-conserved walls, with crack in the retaining wall in the part above the lintel of the door.	Crack resulting from settling of embankment upon which the house stands.	Verify the length of the crack in the embankment wall during the waterproofing process.
CC.02.02	retaining wall sealing	Two half brick walls, each of which are 15 cm thick, and 20-cm layer of air between them. Waterproof seal on the facades of the two walls facing the grounds.	Walls present moisture and infiltrations on the internal facade with light, continuous cracks that extend diagonally.	Cracks resulting from the settling of embankment upon which the house stands. Moisture and infiltrations caused by wear in the waterproof sealing.	Remove the soil against the wall and remove the waterproof sealing. Sand the walls clean and allow them to dry. Check for any structural damage. In the event that there is, evaluate the possibility of building a new wall with a reinforced concrete structure. Build a draining layer of gravel along the wall's entire height with a perforated PVC tube for outflow at the base. Refill with dirt, protecting the layer of gravel and the tube's opening with a geo-textile sheet. Plant grass and bushes in the refilled area.

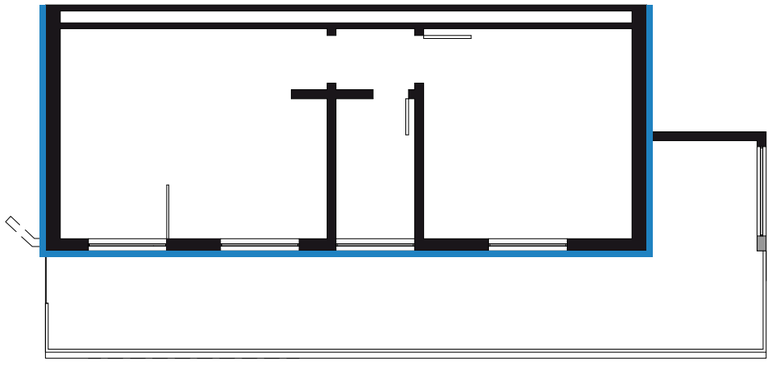


Crack in the retaining wall, advancing into the internal half brick wall, resulting from settling of embankment upon which the house stands.

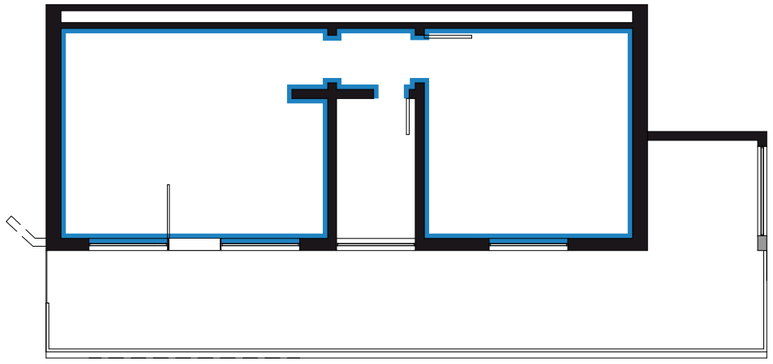


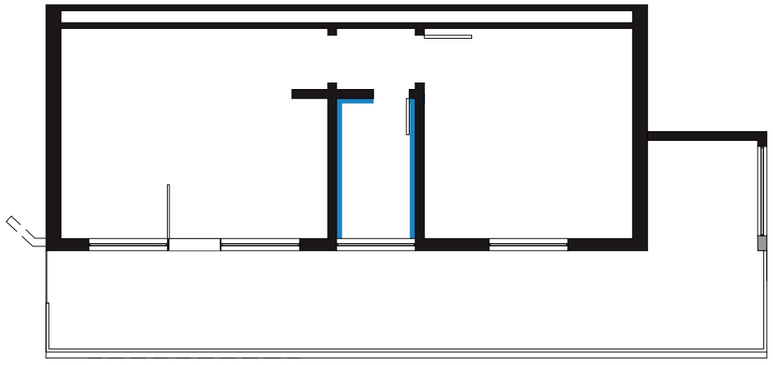
Code	Component	Description	Diagnosis	Identified pathology	Orientations
CC.02.03	external one brick wall sealing	External one brick walls 25 cm thick on the three exposed facades	Walls show no signs of structural damage.		
CC.03.01	finishing on the exposed external walls	Walls clad in roughcast, dash and wall plaster finishing, painted with lime.	Presence of fungi, stains and cracks. Detachment of mortar, efflorescence, fissures and peeling of finishing.	Damage caused by moisture in the environment and lack of eaves to protect from direct rain.	Identical to the main house: annual maintenance with manual scraping of mortar, wash using water jets with chlorine, removal of loose material and replacement of missing mortar. Repaint with lime.



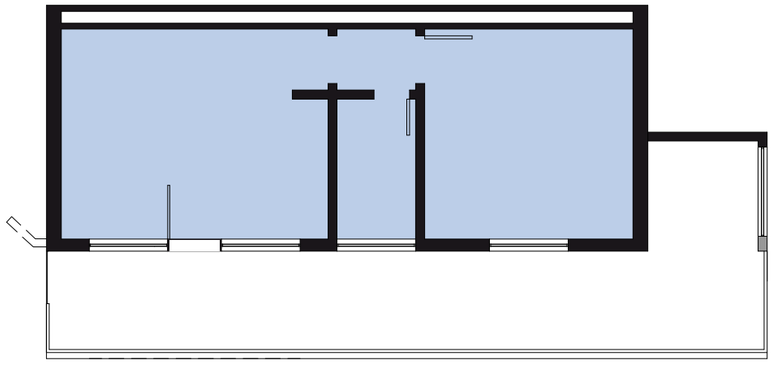


Code	Component	Description	Diagnosis	Identified pathology	Orientations
CC.03.02	internal walls finishing	Internal surfaces with original fine-grained mortar with sand of undetected origin. Painting with latex in white color.	Moisture stains on the internal facades of the external walls.	Moisture from the atmosphere and lack of adequate ventilation.	Periodic cleaning and repainting. Study the opening on the opposite side of the windows to allow for cross ventilation.
CC.03.03	finishing on internal tile walls	Finishing of 15 x 15 cm white tiles. L-shaped cross sections and tiles form a single ensemble. Height of 1.5 m half-beam in the bathroom and 2.10 m in the niche of the countertop sink and stove.	Good state of conservation.		Regular cleaning.



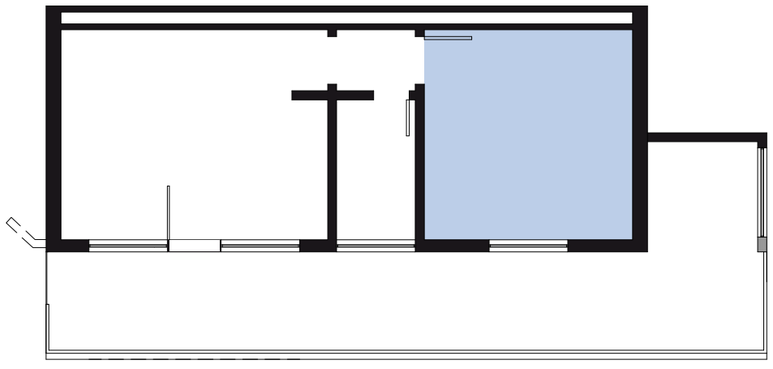


Code	Component	Description	Diagnosis	Identified pathology	Orientations
CC.03.04	ceiling lining	Lower face of the rooftop garden finished in roughcast, dash and wall plaster and painted with lime.	Good state of conservation due to recent cleaning and paint job. There are occasional instances of fungi, stains, displaced mortar, efflorescence and fissures.	Damages caused by infiltration in the slab and the moisture resulting from insufficient ventilation.	After new waterproof sealing is applied to the slab, manually sand the mortar and wash with chlorine, remove the loose material and replace the missing mortar. Repaint with lime.



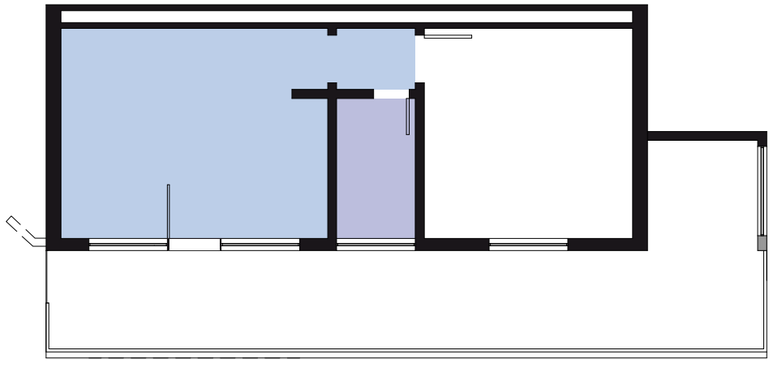
View of the ceiling lining, with irregular in the finishing mortar

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CC.03.05	hardwood floor finishing	Bedroom flooring of waxed Peroba wood (paratecoma peroba), blocks of 5 x 15 cm.	Well conserved material, simply in need of regular cleaning and waxing.		Regular cleaning and waxing.



Peroba wood floor at bedroom

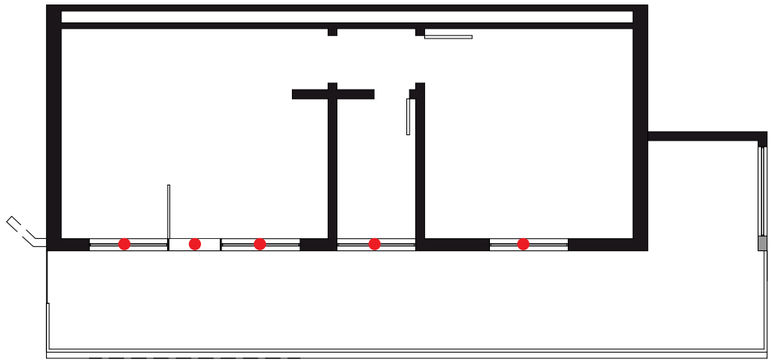
Code	Component	Description	Diagnosis	Identified pathology	Orientations
CC.03.06	red ceramic tile floor finishing	7 x 7 cm red ceramic tile in the main room and kitchen. Hexagonal red ceramic tile in the bathroom. Ceramic threshold on external door with sill	Occasional bulges and broken or loose pieces. Broken thresholds in the internal part and filled in with cement.	Damage caused by undermining in the embankment and/or infiltration of moisture.	Secure loose pieces and preserve original flooring, including broken pieces. Preserve the original flooring as much as possible, since there are no similar pieces on the market to replace it.

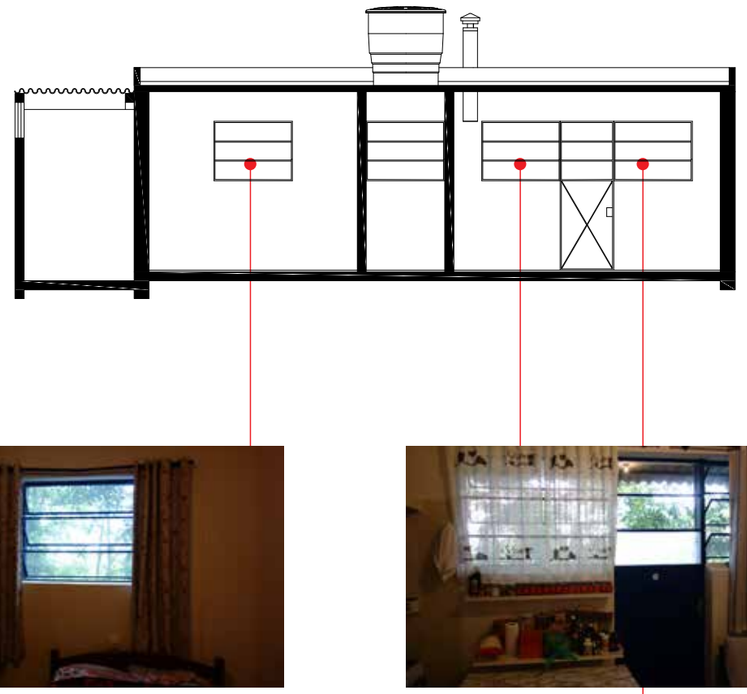


7 x 7 cm red ceramic tile

Hexagonal red ceramic tile

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CC.03.07	bascule casements and metal door	Jalousie window frames in the bedroom, bathroom, main room and kitchen (associated with the metal door). Metal L profiles encasing glass form three pivoting horizontal windows, opened and closed by rod and vertical lever. Door in subdivided L profiles, with the lower part in sheet metal and the upper part with frames encasing windows lined up with bascule windows, comprising a single set of metal frames.	Oxidized casement functioning poorly. Door in good state of conservation, occasional oxidation in the doors and jambs.		Cleaning, chemical removal of oxidized particles and manual scraping of the paint. Repaint with antioxidant base and epoxy paint in the original blue (2945 M, Pantone system). Recuperation of the bascules' movement.



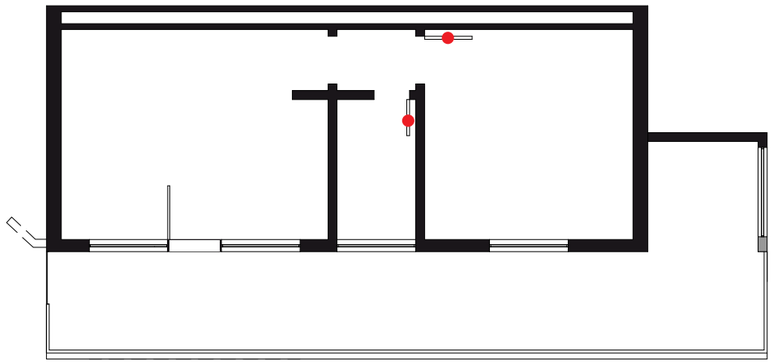


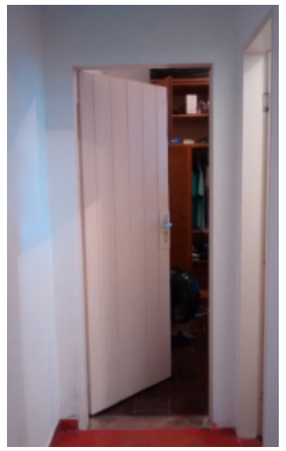
Exterior view of the bascule casements and metal door, mosquito screen and porch

Internal view of the bascule casement of the bedroom

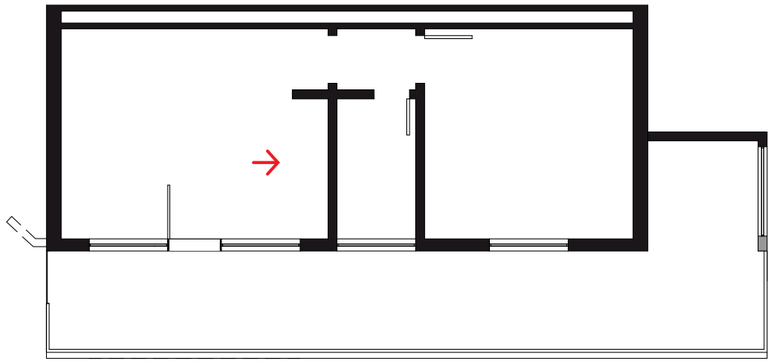
Internal view of the bascule casement and door of the kitchen

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CC.03.08	solid wood doors	Mexican style doors with juxtaposed boards made of solid wood painted white (color 348 M, Pantone system)	Good state of conservation and operation.		Scrape, sand and paint manually, paste over (paste of sawdust and glue). Repaint with synthetic enamel in original color. Conduct a thorough inspection, repairing door handles and locks.



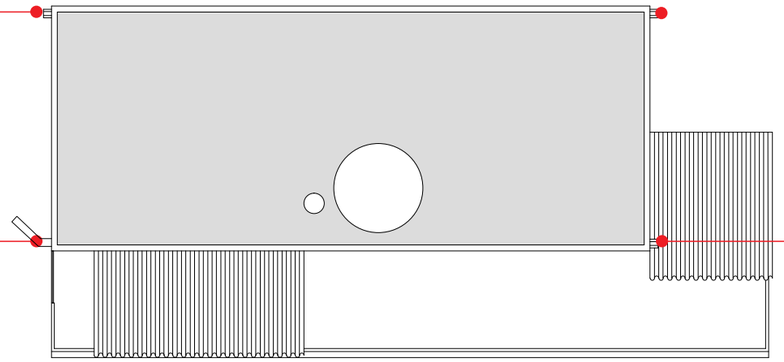


CC.03.09	range hood, counter and niche sink in the kitchen	Sink counter in synthetic marble, stonework cupboard, plywood shelf, metal range hood.	Original range hood and kitchen sink cupboard. Sink and shelves are not original.		Normal cleaning.



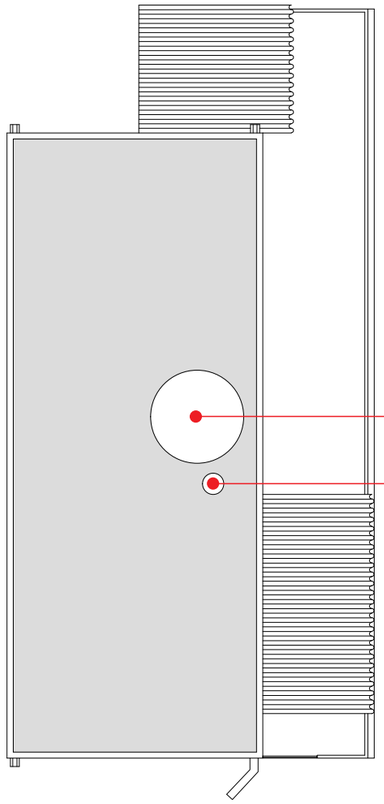
Code	Component	Description	Diagnosis	Identified pathology	Orientations
CC.03.10	Gargoyles for draining rainwater	Concrete gargoyles, one with a complement of galvanized sheet metal painted green (348 M, Pantone system), with the objective of diverting the falling water from the path that leads to the house's entrance.			

Gargoyle complement in galvanized sheet metal painted green.



Gargoyle above the service area.

Code	Component	Description	Diagnosis	Identified pathology	Orientations
CC.03.11	kitchen chimney	Kitchen chimney consisting of sheet metal tube with “Chinese hat” cap.	Though it runs through the garden slab, there are no points of infiltration.		Monitor the conservation of the waterproof seal on the chimney’s collar.
CC.04.01	external water tank	Blue PVC water tank upon stone base of the garden slab. Component that alters the architect’s aesthetic vision, which did not intend for the caretaker’s house to be visible from the main house	Functions adequately.		It should be removed in order to recuperate the aesthetic integrity which the architect conceived for the ensemble, but only after the construction of a new centralized storage tank, proposed for the highest part of the grounds.



Code	Component	Description	Diagnosis	Identified pathology	Orientations
PA.02.05	leisure floors	Horizontal surfaces with pink sandstone flooring set upon a sublayer of reinforced concrete. They represent areas for leisure and rest in the middle of the course through the garden.	Good state of conservation, but the possibility exists of the slabs becoming dislodged.		Reattach the stones with cement mortar whenever dislodging occurs.

PA.02.06	Cat	Cat drawn by Lina Bo Bardi in the wet concrete of the ground blocks in the oven area.	No pathology detected.		Regular cleaning for maintenance.

3.7 Landscaping
PA

The construction of the landscape: the buildings and the garden.

Viewed from 50 meters above its roof, the Glass House practically disappears amidst the covering of vegetation. Planted by Lina Bo Bardi throughout her time living in the house, trees now swallow up the structures, as seen in the photo that opens this section. Despite the beauty of this desired immersion in nature, there is a clear need to establish balance.

A central point in this Conservation Management Plan, the relationship between the buildings and the garden constitute the main identity of the Glass House's architecture. It is the construction of the landscape, encompassing everything from the way it is perceived from the house, with varying degrees of spatial continuity between interior and exterior, to the retaining walls that maintain the soil where it is able to support the planted vegetation and the flooring of the winding walkways.

The work of the team responsible for the landscaping was structured into three approaches:

1
Investigative, seeking to observe and elaborate based on the *historical and temporal construction process of this landscape,* after a survey of the documentation and references in the Bardi Institute's archives. They discovered Lina Bo Bardi's knowledge of and interest in botany, with specialized publications in the library that indicate the continental dimensions of Brazilian landscaping, with its various geographical contexts. In the document archive, they discovered notes on plants purchased from nurseries and the qualities of herbs for the garden. They revealed her daily activities of planting trees and nurturing their growth.

2
Exploratory, contemplating the experience and description of the current state of the Garden, surveying and specifying its plant species, as well as e many qualities present at the locale. This work started from the survey conducted in 2009 by the Institute of Technological Studies, expanding the identification of plant species, updating and correcting it. Conflicts between the vegetation and the buildings were detected, identifying damages already inflicted and potential threats.

3
Proactive, constituted through propositions and the vegetation management plan, revealing potentials perceived from the gathered information and adjustments for future developments. Proposals included the definition of visitation routes on the grounds' walkways, an area for the disposal of waste materials resulting from garden maintenance and alternatives for the installation of ramps and other devices to address the land's intense declivity.

Due to the format of the original A1 project boards, its content was specially adjusted for the format of this report. We opted to present the surveys along with our evaluations and proposed actions. As such, the sections are organized in the following manner:

1
Inventory of built components including floors, walls both low and high, ground design, gates, in short, the various architectural elements distributed throughout the garden.

2
Set of boards with indications of the interventions made in the built components in the garden and based on the orientations for cutting or pruning the trees. By combining the two orientations, it was possible to visualize the relationship between trees and built structures in a single presentation board.

3
Management Plan justification report and tables, with general identification of the species and explanation of the adopted criteria.

4
Set indicating the conditions of the current routes of circulation on the grounds, in particular the existing staircases and ramps, the proposed routes for visitation and their relationship to relevant trees. It includes the proposal to determine storage areas for the organic material produced from pruning and garden upkeep and areas for composting activities.

5
Indication of options for the location of ramps and other apparatuses for universal accessibility.

Image of the Glass House obtained with the use of a drone situated at 756 meters above sea level, 50 meters above the roof of the main house. Overlapping with the plan for implementing structures and pathways. Photo: Júlio Cesar Franco.

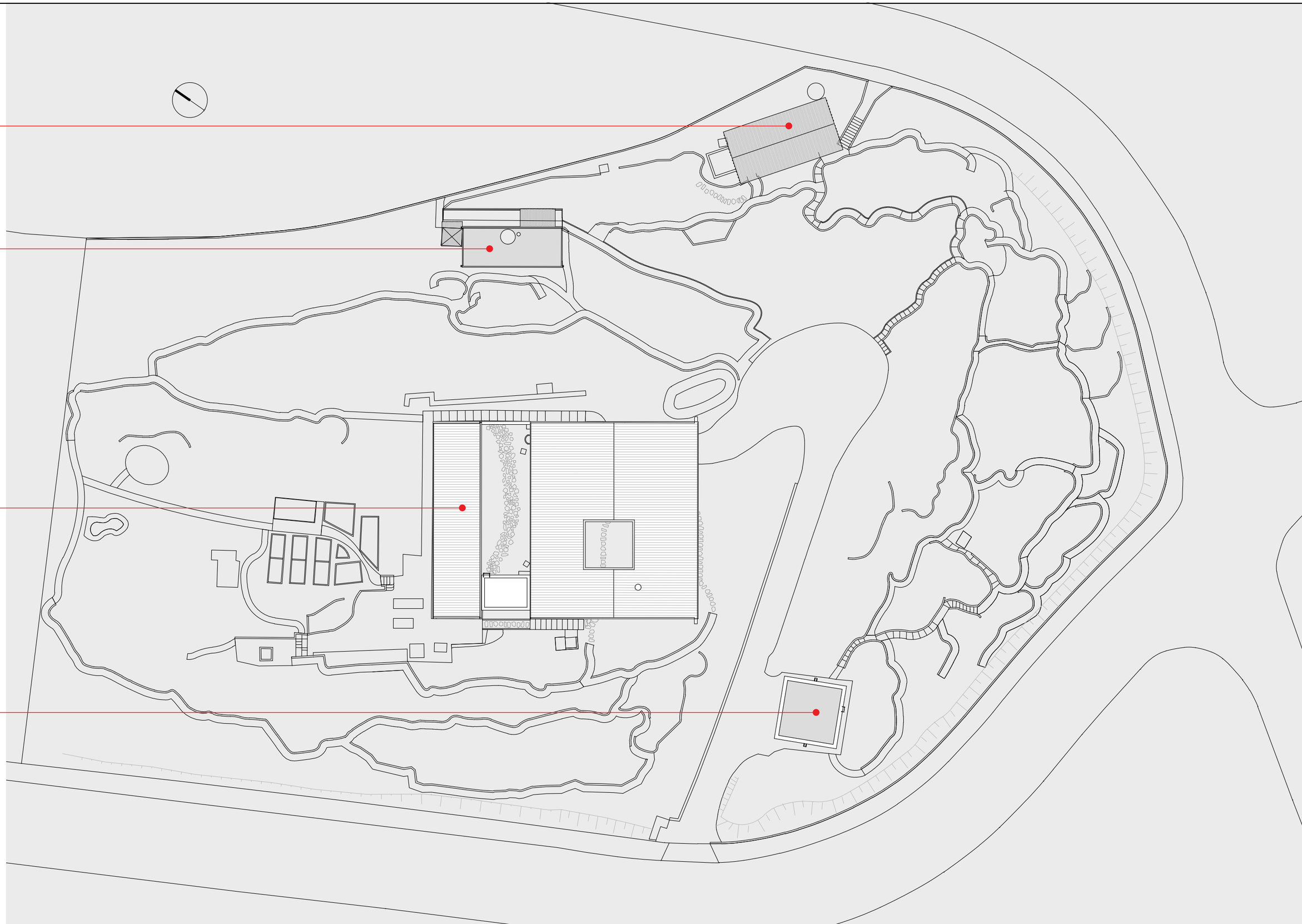
Landscaping

Studio

Caretaker's House

Main House

Garage



Landscaping

PA. 01.01
Retaining walls of granite

PA.02.02
Handrail

PA.02.05
Leisure floors

PA.02.12
Gate at caretaker's house

PA.02.03
Staircases

PA.02.08
Vasca 1 (front)

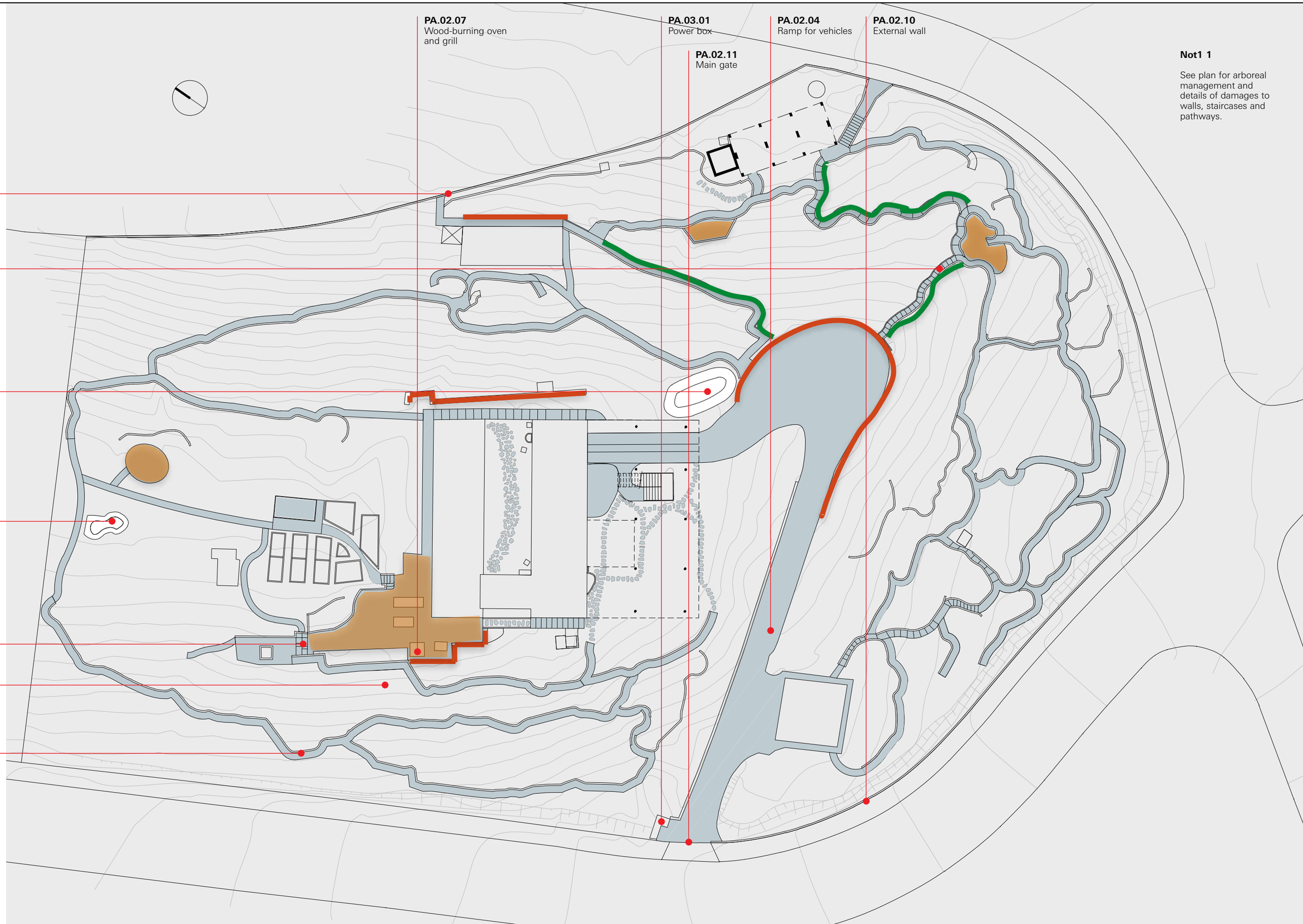
PA.02.08
Vasca 2 (back)

PA.02.06
Cat

PA.01.02
Retaining walls of reinforced concrete under the ovens

PA. 01.03
Low retaining walls in the garden

PA.02.01
External flooring on the garden walkways



Not1 1

See plan for arboreal management and details of damages to walls, staircases and pathways.

Code	Component	Description	Diagnosis	Identified pathology	Orientations
PA. 01.01	retaining walls of granite	Retaining wall made of dry-installed granite stone built according to the *opus incertum* technique (with irregularly shaped, uncut pieces). Thickness up to 80 cm in some places, with dirt and sand on the internal facade. These are the walls that structure the embankment for the ramp, the caretaker's house and the sharpest slope of the grounds next to the main house.	No signs of pathology.		

PA.01.02	retaining wall of reinforced concrete under the ovens	Retaining wall under platform at the back of the house, where the oven and grill are located. Back-up reinforced concrete structure implemented after the original construction with the objective of preventing it from ruin.	Cracks and partial decay in the retaining walls. Contention previously achieved with the fastening of stay cables to the wall which does not entirely impede the continuing risk of ruin. The inclination of the wall warns of the risk of collapse.		Remove the bushes and dirt against the wall in order to evaluate the structure's integrity. If necessary, construct a new internal contention wall, thus relieving the pressure on the original inclined wall. Obs: see the arboreal management plan and details of damage to walls, staircases and walkways

Code	Component	Description	Diagnosis	Identified pathology	Orientations
PA.01.03	low retaining walls in the garden	Low retaining walls of brick, stonework, mortar finishing on the exterior with incrusted pebbles, shards of ceramic and sandstone.	Damages ranging from light cracks to the partial decay of the retaining walls in some sections. Inclined trees and exposed roots overburden the walls.		Trees at risk of falling should be removed according to the diagnosis of the landscapers in the general plan. Reassess the situation after their removal. In some cases, new retaining walls should be constructed within the existing wall to interrupt the degradation. In others, it is necessary to choose between interrupting the ruin or erecting a new wall, appearing clearly as not an original construction. Obs: see the arboreal management plan and details of damage to walls, staircases and walkways.
PA.02.01	external flooring on the garden walkways	Flooring comprised of irregular sandstone slabs, laid directly in the ground or on a small base of mortar.	Displacement of walkway slabs generates instability.		Reattach the stones with cement mortar. Those that happen to be in direct contact with the dirt should be removed. Excavate the dirt and reset the stone. Obs: see the arboreal management plan and details of damage to walls, staircases and walkways.
PA.02.02	handrail	Handrail with flat steel profile and vertical tube volumes in the square section, painted with green enamel (color 348 M, Pantone system). The handrails were molded in situ by a metalworker to accompany the curves of the walkways.			

Handrail accompanying staircase (PA.02.03) and curvature of the low, retaining wall (PA.01.03) along with leisure landing (PA.02.05).

On the path to the studio

Staircase handrail along with vehicle ramp. Recomposition after damages due to automobile crash.

Handrail along the walkway to the caretaker's house.

Code	Component	Description	Diagnosis	Identified pathology	Orientations
PA.02.03	staircases	Staircase with irregular sandstone slab flooring laid on top of a mortar base.	Subject to displacement of slabs, they require constant maintenance.		Reattach the stones with cement mortar.
PA.02.04	ramp for vehicles	Vehicle ramp consisting of two sections with 18% declivity and a smoother, circular landing used for parking. It grants pedestrians access to the main house. Ground surface of pink sandstone slabs set upon a sublayer of reinforced concrete and structured on the side by a retaining walls of large granite blocks. Mortar incrusted with ceramic shards in colorful enamel separate the two tracks for automobile tires on the ramp's first section.	Well preserved, despite the fact that it is subject to constant wear and tear due to the traffic of vehicles. Occasional motor oil stains.		Avoid automobile traffic, regular maintenance. Grout and reset loose stones.

Access ramp for vehicles to the garage

Vehicle access ramp arriving at the threshold with curve alongside the house.

Stones on the ramp surface damaged by the excessive weight of vehicles.

Incrusted ceramic shards in colorful enamel between the two tracks for automobile tires on the ramp's first section.

Curve between the ramp's entrance section and access to the house. Notice the damages in the slabs in the ground.

Curvature of the ground surface between the ramp's two sections.

Code	Component	Description	Diagnosis	Identified pathology	Orientations
PA.02.07	wood-burning oven and grill	Oven and grill built out of stone and masonry according to the tradition in rural São Paulo state. Both are supported on slabs of reinforced concrete, which stand distanced from the ground on pillars of exposed masonry. The grill is topped by a cylindrical asbestos cement chimney with a “Chinese hat” lid.	No pathologies detected in the stonework. Oxidation in the metalwork slab appearing on the bottom facade.		Maintenance with regular cleaning and a yearly coat of limewash paint, as already conducted by the Institute. For the rust on the ironwork, manually sand and wash with water and chlorine and replace missing mortar. Repaint with lime.
PA.02.08	vasca 1 (front)	Amoeba shaped tank made of reinforced concrete to collect rainwater that pours directly from the front gargoyle. For many years, the water level remained high and it was used as a reflecting pool with aquatic plants.	Despite the integrity of its base and side walls, the tank is empty due to the epidemic of dengue fever in the region. Still water serves to proliferate the mosquito that transmits the disease.		Install an aerator to enable the water to once again rise to an elevated level and therefore receive the plants from the original landscape without any risk of disease.

Rainwater falling from the gargoyle into the tank, exemplifying the operation planned by the architect.

Tank kept dry due to the risk of disease

Code	Component	Description	Diagnosis	Identified pathology	Orientations
PA.02.09	vasca 2 (back)	Amoeba-shaped tank made of reinforced concrete with edges covered in mortar with tumbled pebbles.	The tank is abandoned, at the back of the grounds, but conserved without apparent damage.		Regular cleaning. Could possibly serve as receptacle for plant beds.

View of empty water tank, but accumulating debris and tree leaves.

Edges of the tank covered in mortar with tumbled pebbles.

PA.02.10	external wall	Enclosure walls made of exposed concrete blocks, built in 1978.	Good state of conservation despite exposure to the elements. Portions covered in vines and climbing plants.		Regular maintenance to avoid increases in the area covered by vegetation.

external wall of exposed concrete blocks in a good state of conservation despite exposure to the elements and being covered in vines and climbing plants.

Part of the wall near the gate using the same finishing as on the retaining walls and the garage walls. Identification of the house number and the mailbox in cast iron.

Code	Component	Description	Diagnosis	Identified pathology	Orientations
PA.02.11	main gate	The property's main entrance gate, built in 1981. Running on a track, it has a metal screen structured in folded metal sheets and tubes. Activated by electrical motor and gears. Painted green.	The motor presents recurring damages attributed to the weight of the gate.		

Internal view of the gate where the damaged metal screen, rack, electric motor and gear can be observed.

Internal view of the ramp, gate and power box.

PA.02.12	gate at caretaker's house	The gate at the caretaker's house leads to Rua Seguidilha and, from there, Rua Bandeirante Sampaio Soares. Metal sheet structured in steel profile frame.	Good working state. Poorly executed maintenance paint job, left half in the original green, half blue.		Regular maintenance and painting in the original green color.

Code	Component	Description	Diagnosis	Identified pathology	Orientations
PA.03.01	power box	Power box constructed during the renovation of the power grid in 2012. Though made of new materials, the intention was for it to mimic the mortar finishing with pebbles on the other walls and retaining walls.	Good state of conservation.		Regular maintenance.
					
PA.03.02	external elevated tubes	tubes for electrical, data, telephone wires and water installed on volumes, elevated from the ground to avoid damage to the garden's vegetation and architectural components.	Interference in circulation at certain points.		The tubes can be lowered only in the passages along the walkways, thus remaining at ground level, without being burying. Points 30, 32, 35, 81, 82, 83 (arboreal management plan and details of damages to walls, staircases and walkways. Sheets 1, 2 and 3)
	 				
PA.03.03	lamp post	Lamp post for urban lighting, common at the time of construction, distributed alongs the main access ramp.	Good state of conservation.		Regular maintenance
					

Management Plan of the Tree Vegetation and low retaining walls, stairs and ramps damages. Key map.

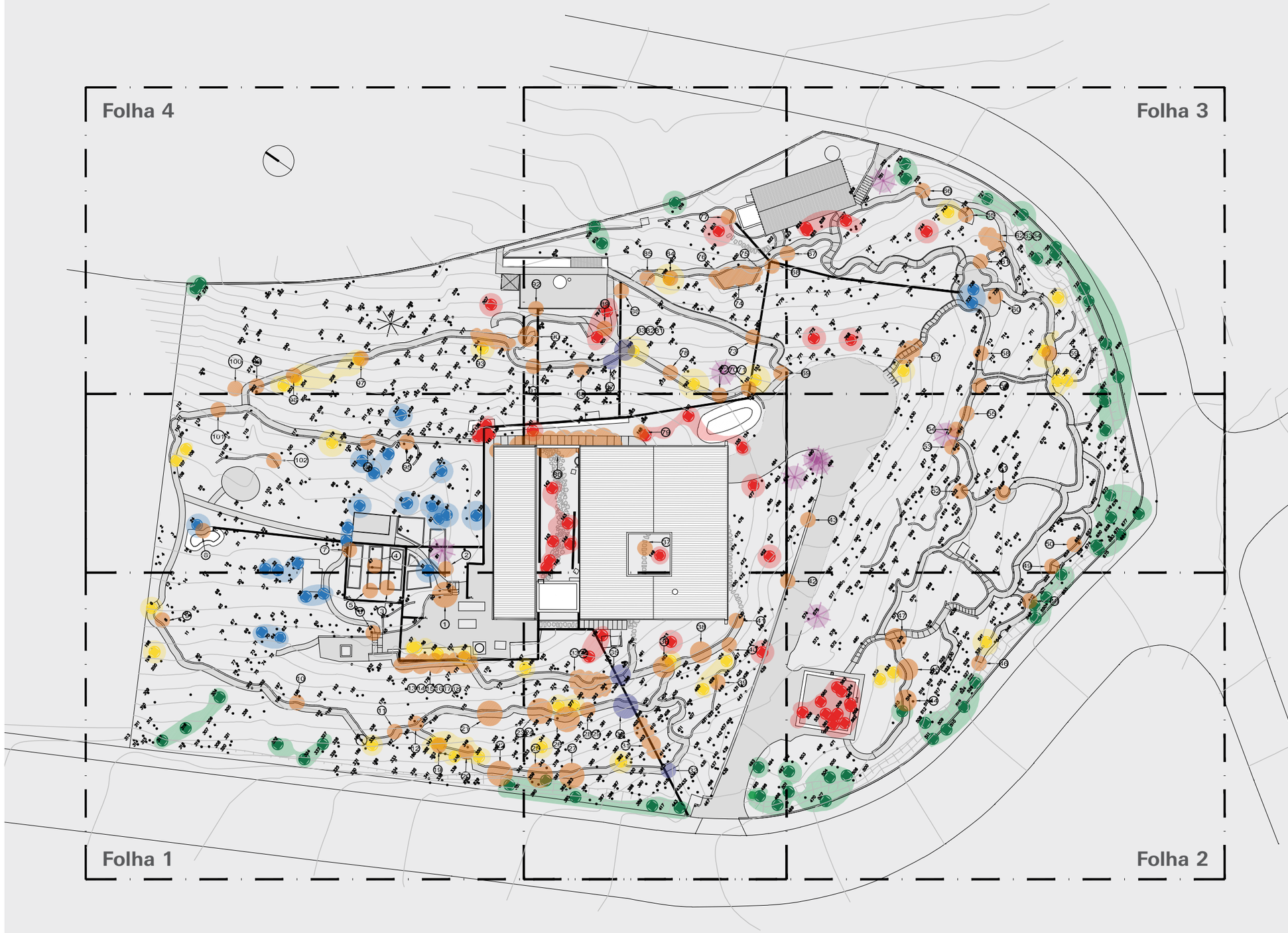
1
Management Plan of the Tree Vegetation

- Interference between tree vegetation and boundary walls
- Interference between tree vegetation and garden infrastructure
- Interference between tree vegetation and garden environments
- Interference between tree vegetation and buildings
- The environmental relevance of tree species vs. its phytosanitary status and potential for biological invasion
- Tree to be suppressed by shallow felling
- Tree to be pruned for crown rebalancing

2
Low retaining walls, stairs and ramps damages

- (43) see numbered photos as indicated

3
External elevated tubes



Interference between tree vegetation and boundary walls:

Along the perimeter of the limiting walls it was registered 56 trees that pose risks both to the walls and, mainly, to the external electrical network, since they are under the aerial cables or interspersed to them. These are situations in which prudence demands the removal of those plants, since pruning would only postpone the potential problem to future times. In this sense, since no plants of environmental or landscape relevance among those selected for removal were identified at these sites, it is suggested that all plants should be properly suppressed.

Interference between tree vegetation and garden infrastructure:

The garden infrastructure assessment team pointed out the total number of 39 trees that interfered with the paths, retaining walls, floors and the electrical and hydraulic networks internal to the property. Evaluated individually, the following situations were found in the field, according to the view of the tree management team:

- 39 Situations (37 removals and 2 prunings) in which trees are destroying or presenting an immediate risk to some garden infrastructure and should be suppressed immediately.

- Situations where trees no longer pose a risk of destruction of infrastructure, being such structures deteriorated or in need of repairs which, in order to be carried out, should meet specific technical criteria and/or standards and, therefore, it will be more advantageous to rebuild the infrastructure and maintain the vegetation as it presently is, preserved with pruning actions aiming balance.

Interference between tree vegetation and garden environments:

Throughout the process of evaluating the potentialities of the Glass House garden, it was defined that some environments should be recovered, recreated or reused for educational purposes, following the logic of "intentionality" verified in the correspondences between Lina and Pietro, aiming to reconstitute situations that would have brought joy to both the visitors and the institution, such as the Vegetable Garden, the Vasca and some Platforms in the garden, which have educational and cultural potential, within the line of visitation intended for the garden. In this way, 19 trees have been identified that must be removed, and 4 trees must have their crowns pruned, either for their growing or for opening and balancing, so that it is possible to have a higher incidence of light in these environments, in order to allow the suggested uses to be materialized. The main case of this modality is the environment of the Vegetable Garden. Since it was established by the landscaping team that this environment, properly recovered, should be the object of a visitation route, it was indispensable that it could count on greater luminosity for the production of the vegetables.

Interference between tree vegetation and buildings:

Along the perimeter of the main building, 21 trees were identified as posing risks to the architecture, 20 with imminent risk of fall that should be removed immediately, and 1 that should be observed in a more attentive way, coordinated with other actions in the garden, in addition to the pruning for balancing and clearing in all other trees near the residence, as a precaution.

In the Garage area, 12 trees located in their direct surroundings should be removed, of which 11 are located on the cover slab, posing the risk of structural collapse.

In the surroundings of the Studio there are 6 trees that must be removed to prevent future damages, besides a large individual that demands pruning and the other pruning actions for balance of the nearby trees and bamboo clumps. One individual tree must be kept in observation.

In the region of the Caretaker's House, 3 trees that are close around it, especially in areas higher than the building, not forgetting to carry out the pruning for balance and conduction in other nearby trees.

In total, as can be seen in the Table of Tree Management due to Conflict with the Buildings, 40 trees will be immediately removed for posing risks to the integrity of the buildings, as well as 2 individual trees that should receive balance and conduction pruning as a form of prevention of future accidents, and 2 others that should be monitored constantly.

The environmental relevance of tree species vs. its phytosanitary status and potential for biological invasion:

In some cases, it is clear that some tree species are in senescence, that is, in terminal phase, offering a potential risk of fall of branches or of the whole individual, as well as being considered vectors of pests such as termites, parasites that can harm the newer, healthier trees on the property. It is also noticed the presence of exotic species considered invasive in the city of São Paulo, in the case of the Seafórtias (Archontophoenix cunninghamii) constituting a risk of unbridled proliferation and imbalance in the garden, as observed in the woods of USP, in the Park Tenente Siqueira Campos (Trianon), among other places in the capital. Finally, some trees are located very close to nobler individuals, representing a risk to these environmentally more relevant plants, since they are more susceptible to have their branches fallen.

In some situations, the tree vegetation presented excessive cracks in the trunks, broken branches and sometimes even the crowns destroyed by the fall of some nearby tree, victims of high winds and rains, being classified in the Vegetation Register Table as "Dead", phasing out even their botanical identification. For these cases, it was suggested to remove the remaining parts, be they trunks, branches or laps, so the soil could be released for eventual adjustments of topography, shrubs or infrastructure, always accompanied by photos to prove the truth of the existing situation.

Management Plan of the Tree Vegetation

Nº Item	Nº da plaqueta	Nome popular	Família botânica	Nome científico	Origem	Altura total	DAP1	DAP2	DAP3	DAP4	∑ Do diâmetro quadrático	Estado fitossanitário	Manejo pretendido	Categoria de manejo/ interferência
1	137	Abacateiro	Lauraceae	*Persia gratíssima*	*Exótica*	*8,5*	*37,00*	*0,00*	*0,00*	*0,00*	*37,00*		*Remoção*	2.01-Edificação
2	138	Figueira	Moraceae	*Ficus sp.*	*Nativa*	*8,0*	*30,00*	*0,00*	*0,00*	*0,00*	*30,00*		*Remoção*	2.01-Edificação
3	140	Figueira	Moraceae	*Ficus sp.*	*Nativa*	*6,5*	*15,00*	*0,00*	*0,00*	*0,00*	*15,00*		*Remoção*	2.01-Edificação
4	141	Jaqueira	Moraceae	*Artocarpus integrifolia*	*Exótica*	*11,0*	*37,00*	*0,00*	*0,00*	*0,00*	*37,00*		*Remoção*	2.01-Edificação
5	142	NI	NI	*Não identificada*	*NI*	*8,0*	*12,00*	*0,00*	*0,00*	*0,00*	*0,00*		*Remoção*	2.01-Edificação
6	143	Pau-incenso	Pittosporaceae	*Pitosporum undulatum*	*Exótica*	*8,0*	*12,00*	*0,00*	*0,00*	*0,00*	*0,00*		*Remoção*	2.01-Edificação
7	144	Pimentinha Erythroxylum	Erythroxylaceae	*Erythroxylum sp.*	*Nativa*	*7,0*	*8,00*	*0,00*	*0,00*	*0,00*	*0,00*		*Remoção*	2.01-Edificação
8	145	Pau-óleo	Euphorbiaceae	*Alchornea sp.*	*Nativa*	*6,0*	*14,00*	*0,00*	*0,00*	*0,00*	*0,00*		*Remoção*	2.01-Edificação
9	146	Mangueira	Anacardiaceae	*Mangifera indica*	*Exótica*	*7,0*	*10,00*	*0,00*	*0,00*	*0,00*	*0,00*		*Remoção*	2.01-Edificação
10	147	Pau-de-leite	Sapium biglandulosus	*Sapium biglandulosus*	*Nativa*	*8,0*	*12,00*	*0,00*	*0,00*	*0,00*	*0,00*		*Remoção*	2.01-Edificação
11	148	Falsa-seringueira	Moraceae	*Ficus elastica var. decora*	*Exótica*	*14,0*	*1,50*	*0,00*	*0,00*	*0,00*	*0,00*		*Remoção*	2.01-Edificação
12	149	Falsa-seringueira	Moraceae	*Ficus elastica var. decora*	*Exótica*	*10,0*	*70,00*	*0,00*	*0,00*	*0,00*	*70,71*		*Remoção*	2.01-Edificação
13	150	Falsa-seringueira	Moraceae	*Ficus elastica var. decora*	*Exótica*	*6,0*	*17,00*	*0,00*	*0,00*	*0,00*	*17,00*		*Remoção*	2.01-Edificação
14	155	Jerivá	Arecaceae	*Syagrus romanzoffiana*	*Nativa*	*10,0*	*18,00*	*0,00*	*0,00*	*0,00*	*18,00*		*Remoção*	2.01-Edificação
15	159	Jaqueira	Moraceae	*Artocarpus heterophyllus*	*Exótica*	*8,0*	*10,00*	*0,00*	*0,00*	*0,00*	*10,00*		*Remoção*	2.01-Edificação
16	162	Canela Vermelha	Lauraceae	*Ocotea sp.*	*Nativa*	*12,0*	*32,00*	*0,00*	*0,00*	*0,00*	*32,00*		*Remoção*	2.01-Edificação
17	445	Almecegueira	Burseraceae	*Protium heptaphyllum*	*Nativa*	*7,0*	*20,00*	*0,00*	*0,00*	*0,00*	*20,00*		*Remoção*	2.01-Edificação
18	452	NI	NI	*Não identificada (não coletada)*	*NI*	*5,0*	*16,00*	*0,00*	*0,00*	*0,00*	*16,00*		*Remoção*	2.01-Edificação
19	463	Casuarina	Casuarinaceae	*Casuarina equisetifolia*	*Exótica*	*15,0*	*55,00*	*0,00*	*0,00*	*0,00*	*55,00*		*Remoção*	2.01-Edificação
20	477	Sibipiruna	Fabaceae	*Caesalpinia pluviosa*	*Nativa*	*12,0*	*38,00*	*0,00*	*0,00*	*0,00*	*38,00*		*Observar*	2.01-Edificação
21	556	Painera-rosa	Bombacaceae	*Chorisia speciosa*	*Nativa*	*3,0*	*7,00*	*0,00*	*0,00*	*0,00*	*7,00*		*Remoção*	2.01-Edificação
22	559	NI	NI	*Não identificada (não coletada)*	*NI*	*3,0*	*4,00*	*0,00*	*0,00*	*0,00*	*4,00*		*Remoção*	2.01-Edificação
23	560	Machaerium	Fabaceae	*Machaerium sp.*	*Nativa*	*7,0*	*11,00*	*5,00*	*0,00*	*0,00*	*12,08*		*Remoção*	2.01-Edificação
24	561	Pau Jacaré	Fabaceae	*Piptadenia gonoacantha*	*Nativa*	*6,0*	*10,00*	*0,00*	*0,00*	*0,00*	*10,00*		*Remoção*	2.01-Edificação
25	562	Sibipiruna	Fabaceae	*Caesalpinia pluviosa*	*Nativa*	*11,0*	*22,00*	*0,00*	*0,00*	*0,00*	*22,00*		*Remoção*	2.01-Edificação
26	563	Machaerium	Fabaceae	*Machaerium sp.*	*Nativa*	*8,0*	*11,00*	*0,00*	*0,00*	*0,00*	*11,00*		*Remoção*	2.01-Edificação
27	564	Machaerium	Fabaceae	*Machaerium sp.*	*Nativa*	*3,0*	*7,00*	*0,00*	*0,00*	*0,00*	*7,00*		*Remoção*	2.01-Edificação
28	565	Nespereira	Rosaceae	*Eriobotrya japonica*	*Exótica*	*3,0*	*7,00*	*0,00*	*0,00*	*0,00*	*7,00*		*Remoção*	2.01-Edificação
29	566	Pau Jacaré	Fabaceae	*Piptadenia gonoacantha*	*Nativa*	*6,0*	*12,00*	*0,00*	*0,00*	*0,00*	*12,00*		*Remoção*	2.01-Edificação
30	744	NI	NI	*Não identificada (não coletada)*		*10,0*	*24,00*	*0,00*	*0,00*	*0,00*	*24,00*		*Remoção*	2.01-Edificação
31	768	Canafístula	Fabaceae	*Peltophorum dubium*	*Nativa*	*10,0*	*50,00*	*0,00*	*0,00*	*0,00*	*50,00*		*Poda*	2.01-Edificação
32	772	Tipuana	Fabaceae	*Tipuana tipu*	*Exótica*	*15,0*	*50,00*	*0,00*	*0,00*	*0,00*	*50,00*		*Remoção*	2.01-Edificação
33	797	Almecegueira	Burseraceae	*Protium heptaphyllum*	*Nativa*	*7,0*	*18,00*	*20,00*	*0,00*	*0,00*	*26,91*		*Remoção*	2.01-Edificação
34	801	NI	NI	*Não identificada (não coletada)*		*5,0*	*28,00*	*0,00*	*0,00*	*0,00*	*28,00*		*Remoção*	2.01-Edificação
35	807	Abacateiro	Lauraceae	*Persea gratissima*	*Exótica*	*8,0*	*23,00*	*0,00*	*0,00*	*0,00*	*23,00*		*Remoção*	2.01-Edificação
36	818	Pau Jacaré	Fabaceae	*Piptadenia gonoacantha*	*Nativa*	*12,0*	*40,00*	*35,00*	*0,00*	*0,00*	*53,15*		*Remoção*	2.01-Edificação
37	824	NI	NI	*Não identificada*		*9,0*	*20,00*	*0,00*	*0,00*	*0,00*	*20,00*		*Remoção*	2.01-Edificação
38	825	Almecegueira	Burseraceae	*Protium heptaphyllum*	*Nativa*	*7,0*	*11,00*	*0,00*	*0,00*	*0,00*	*11,00*		*Remoção*	2.01-Edificação
39	826	Pau Jacaré	Fabaceae	*Piptadenia gonoacantha*	*Nativa*	*12,0*	*18,00*	*0,00*	*0,00*	*0,00*	*18,00*		*Observar*	2.01-Edificação
40	827	NI	NI	*Não identificada*		*8,0*	*12,00*	*0,00*	*0,00*	*0,00*	*12,00*		*Remoção*	2.01-Edificação
41	24	Almecegueira	Burseraceae	*Protium heptaphyllum*	*Nativa*	*8,0*	*23,00*	*23,00*	*0,00*	*0,00*	*32,53*		*Poda*	2.02- Ambientes
42	31	NI	NI	*Não identificada*		*6,5*	*9,00*	*0,00*	*0,00*	*0,00*	*9,00*		*Remoção*	2.02- Ambientes
43	32	Uvaieira	Myrtaceae	*Eugenia pyriformis*	*Nativa*	*7,5*	*12,00*	*0,00*	*0,00*	*0,00*	*12,00*		*Remoção*	2.02- Ambientes
44	35	Pimentinha-do-mato	Erythroxylaceae	*Erythroxylum sp.*	*Nativa*	*8,0*	*34,00*	*0,00*	*0,00*	*0,00*	*34,00*		*Remoção*	2.02- Ambientes
45	38	Abacateiro	Lauraceae	*Persea gratissima*	*Exótica*	*8,0*	*25,00*	*0,00*	*0,00*	*0,00*	*25,00*		*Remoção*	2.02- Ambientes

Nº Item	Nº da plaqueta	Nome popular	Família botânica	Nome científico	Origem	Altura total	DAP1	DAP2	DAP3	DAP4	∑ do diâmetro quadrático	Estado fitossanitário	Manejo pretendido	Categoria de manejo/ interferência
46	39	Abacateiro	Lauraceae	*Persea gratissima*	*Exótica*	*12,0*	*22,00*	*0,00*	*0,00*	*0,00*	*22,00*		*Remoção*	2.02- Ambientes
47	51	Figueira	Moraceae	*Ficus sp.*	*Nativa*	*9,0*	*34,00*	*0,00*	*0,00*	*0,00*	*34,00*		*Remoção*	2.02- Ambientes
48	52	NI	Myrtaceae	*Não identificada (não coletada)*	*Nativa*	*6,0*	*12,00*	*0,00*	*0,00*	*0,00*	*12,00*		*Remoção*	2.02- Ambientes
49	83	Kauri	Araucariaceae	*Agathis australis*	*Exótica*	*7,0*	*16,00*	*0,00*	*0,00*	*0,00*	*16,00*		*Poda*	2.02- Ambientes
50	84	NI	NI	*Não identificada*		*8,0*	*24,00*	*0,00*	*0,00*	*0,00*	*24,00*		*Remoção*	2.02- Ambientes
51	85	NI	Myrtaceae	*Não identificada (não coletada)*		*8,0*	*15,00*	*14,00*	*28,00*	*0,00*	*34,71*		*Poda*	2.02- Ambientes
52	91	Jerivá	Arecaceae	*Syagrus romanzoffiana*	*Nativa*	*8,0*	*13,00*	*0,00*	*0,00*	*0,00*	*13,00*		*Remoção*	2.02- Ambientes
53	92	Jerivá	Arecaceae	*Syagrus romanzoffiana*	*Nativa*	*19,0*	*18,00*	*0,00*	*0,00*	*0,00*	*18,00*		*Remoção*	2.02- Ambientes
54	96	Pau-óleo	Euphorbiaceae	*Alchornea sp.*	*Nativa*	*8,0*	*20,00*	*0,00*	*0,00*	*0,00*	*20,00*		*Remoção*	2.02- Ambientes
55	122	NI	Myrtaceae	*Não identificada (não coletada)*	*Nativa*	*3,0*	*7,00*	*0,00*	*0,00*	*0,00*	*7,00*		*Remoção*	2.02- Ambientes
56	124		Sapindaceae	*Cupania sp.*	*Nativa*	*7,0*	*8,00*	*10,00*	*26,00*	*0,00*	*28,98*		*Remoção*	2.02- Ambientes
57	126	NI	NI	*Não identificada*		*12,0*	*26,00*	*0,00*	*0,00*	*0,00*	*26,00*		*Remoção*	2.02- Ambientes
58	130	Figueira	Moraceae	*Ficus sp.*	*Nativa*	*8,0*	*35,00*	*0,00*	*0,00*	*0,00*	*35,00*		*Remoção*	2.02- Ambientes
59	135	Abacateiro	Lauraceae	*Persea gratissima*	*Exótica*	*8,0*	*20,00*	*0,00*	*0,00*	*0,00*	*20,00*		*Remoção*	2.02- Ambientes
60	230	Cafezinho-do-mato	Celastraceae	*Maytenus floribunda*	*Nativa*	*9,0*	*30,00*	*0,00*	*0,00*	*0,00*	*30,00*		*Remoção*	2.02- Ambientes
61	64	NI	NI	*Não identificada*		*8,0*	*33,00*	*0,00*	*0,00*	*0,00*			*Poda*	2.02- Ambientes
62	736	Angelim	Fabaceae	*Andira surinamensis*	*Nativa*	*5,0*	*7,00*	*0,00*	*0,00*	*0,00*	*7,00*		*Remoção*	2.02- Ambientes
63	737	NI	NI	*Não identificada (não coletada)*		*8,0*	*11,00*	*11,00*	*0,00*	*0,00*	*15,56*		*Remoção*	2.02- Ambientes
64	267	NI	NI	*Não identificada*		*6,0*	*5,00*	*22,00*	*17,00*	*0,00*	*6,00*		*Remoção*	2.03- Muros de divisa
65	279	NI	NI	*Não identificada (não coletada)*		*4,0*	*6,00*	*0,00*	*0,00*	*0,00*	*6,00*		*Remoção*	2.03- Muros de divisa
66	304	Camboatá-vermelho	Sapindaceae	*Cupania vernalis*	*Nativa*	*10,0*	*35,00*	*0,00*	*0,00*	*0,00*	*35,00*		*Remoção*	2.03- Muros de divisa
67	316	NI	NI	*Não identificada (não coletada)*		*3,0*	*7,00*	*0,00*	*0,00*	*0,00*	*7,00*		*Remoção*	2.03- Muros de divisa
68	317	Açoita cavalo	Luehea	*Luehea sp*	*Nativa*	*10,0*	*36,00*	*30,00*	*0,00*	*0,00*	*46,86*		*Remoção*	2.03- Muros de divisa
69	322	NI	NI	*Não identificada*		*8,0*	*21,00*	*0,00*	*0,00*	*0,00*	*21,00*		*Remoção*	2.03- Muros de divisa
70	324	Pixirica	Melastomataceae	*Miconia pusiliiflora*	*Nativa*	*8,0*	*25,00*	*25,00*	*0,00*	*0,00*	*35,36*		*Remoção*	2.03- Muros de divisa
71	327	Açoita cavalo	Luehea	*Luehea sp*	*Nativa*	*9,0*	*40,00*	*0,00*	*0,00*	*0,00*	*40,00*		*Remoção*	2.03- Muros de divisa
72	351	Camboatá-vermelho	Sapindaceae	*Cupania vernalis*	*Nativa*	*3,0*	*4,00*	*7,00*	*0,00*	*0,00*	*8,06*		*Remoção*	2.03- Muros de divisa
73	361	Aroeira	Anacardiaceae	*Não identificada (não coletada)*	*Nativa*	*15,0*	*30,00*	*0,00*	*0,00*	*0,00*	*30,00*		*Remoção*	2.03- Muros de divisa
74	365	Açoita cavalo	Luehea	*Luehea sp*	*Nativa*	*4,0*	*18,00*	*0,00*	*0,00*	*0,00*	*18,00*		*Remoção*	2.03- Muros de divisa
75	417	NI		*Não identificada*		*5,0*	*7,00*	*0,00*	*0,00*	*0,00*	*7,00*		*Remoção*	2.03- Muros de divisa
76	443	NI	Lauraceae	*Não identificada (não coletada)*		*6,0*	*5,00*	*7,00*	*7,00*	*10,00*	*14,93*		*Remoção*	2.03- Muros de divisa
77	468	Figueira	Moraceae	*Ficus sp. 1*	*Nativa*	*4,0*	*7,00*	*0,00*	*0,00*	*0,00*	*7,00*		*Remoção*	2.03- Muros de divisa
78	493	Pau-incenso	Pittosporaceae	*Pittosporum undulatum*	*Exótica*	*6,0*	*12,00*	*0,00*	*0,00*	*0,00*	*12,00*		*Remoção*	2.03- Muros de divisa
79	495	Eucalipto	Myrtaceae	*Eucalyptus sp.*	*Exótica*	*16,0*	*65,00*	*0,00*	*0,00*	*0,00*	*65,00*		*Poda*	2.03- Muros de divisa
80	496	NI	NI	*Não identificada (não coletada)*		*7,0*	*12,00*	*0,00*	*0,00*	*0,00*	*65,00*		*Remoção*	2.03- Muros de divisa
81	497	Pau-incenso	Pittosporaceae	*Pittosporum undulatum*	*Exótica*	*5,00*	*10,00*	*0,00*	*0,00*	*0,00*	*10,00*		*Remoção*	2.03- Muros de divisa
82	504	Pixirica	Melastomataceae	*Miconia selloviana*	*Nativa*	*10,0*	*33,00*	*0,00*	*0,00*	*0,00*	*33,00*		*Remoção*	2.03- Muros de divisa
83	506	Figueira	Moraceae	*Ficus sp.*	*Nativa*	*2,0*	*15,00*	*0,00*	*0,00*	*0,00*	*8,00*		*Remoção*	2.03- Muros de divisa
84	507	Camboatá-vermelho	Sapindaceae	*Cupania vernalis*	*Nativa*	*3,0*	*8,00*	*0,00*	*0,00*	*0,00*	*8,00*		*Remoção*	2.03- Muros de divisa
85	508	Pau-marfim	Rutaceae	*Balfourodendron riedellianum*	*Nativa*	*6,0*	*8,00*	*0,00*	*0,00*	*0,00*	*8,00*		*Remoção*	2.03- Muros de divisa
86	510	Pau Jacaré	Fabaceae	*Piptadenia gonoacantha*	*Nativa*	*5,0*	*12,00*	*0,00*	*0,00*	*0,00*	*12,00*		*Remoção*	2.03- Muros de divisa
87	511	Tapi	Euphorbiaceae	*Alchornea triplinervia*	*Nativa*	*8,0*	*30,00*	*0,00*	*0,00*	*0,00*	*30,00*		*Remoção*	2.03- Muros de divisa
88	513	Nespereira	Rosaceae	*Eriobotrya japonica*	*Exótica*	*7,0*	*15,00*	*0,00*	*0,00*	*0,00*	*15,00*		*Remoção*	2.03- Muros de divisa
89	519	Machaerium	Fabaceae	*Machaerium sp.*	*Nativa*	*6,0*	*16,00*	*0,00*	*0,00*	*0,00*	*16,00*		*Remoção*	2.03- Muros de divisa
90	525	Guaçatonga	Fabaceae	*Casearia sylvestris*	*Nativa*	*2,5*	*12,00*	*0,00*	*0,00*	*0,00*	*12,00*		*Remoção*	2.03- Muros de divisa

Nº Item	Nº da plaqueta	Nome popular	Família botânica	Nome científico	Origem	Altura total	DAP1	DAP2	DAP3	DAP4	∑ Do diâmetro quadrático	Estado fitossanitário	Manejo pretendido	Categoria de manejo/ interferência
91	548	Machaerium	Fabaceae	*Machaerium sp.*	*Nativa*	*5,0*	*10,00*	*10,00*	*0,00*	*0,00*	*14,14*		*Remoção*	2.03- Muros de divisa
92	549	Machaerium	Fabaceae	*Machaerium sp.*	*Nativa*	*15,0*	*47,00*	*24,00*	*22,00*	*43,00*	*71,54*		*Remoção*	2.03- Muros de divisa
93	551	Machaerium	Fabaceae	*Machaerium sp.*	*Nativa*	*15,0*	*30,00*	*14,00*	*30,00*	*0,00*	*44,68*		*Remoção*	2.03- Muros de divisa
94	555	Pau-incenso	Pittosporaceae	*Pittosporum undulatum*	*Exótica*	*7,0*	*40,00*	*0,00*	*0,00*	*0,00*	*40,00*		*Remoção*	2.03- Muros de divisa
95	671	Capororoca	Primulaceae	*Rapanea umbellata*	*Nativa*	*3,5*	*5,00*	*0,00*	*0,00*	*0,00*	*5,00*		*Remoção*	2.03- Muros de divisa
96	673	Capororoca Branco	Myrsinaceae	*Não identificada (não coletada)*	*Nativa*	*5,5*	*14,00*	*0,00*	*0,00*	*0,00*	*14,00*		*Remoção*	2.03- Muros de divisa
97	674	Bico-de-pato	Fabaceae	*Machaerium nictitans*	*Nativa*	*7,0*	*12,00*	*0,00*	*0,00*	*0,00*	*12,00*		*Remoção*	2.03- Muros de divisa
98	675	Vassourão	Clethraceae	*Clethea scabra*	*Nativa*	*6,0*	*10,00*	*0,00*	*0,00*	*0,00*	*10,00*		*Remoção*	2.03- Muros de divisa
99	678	Capororoca Branco	Myrsinaceae	*Não identificada (não coletada)*	*Nativa*	*4,0*	*10,00*	*0,00*	*0,00*	*0,00*	*10,00*		*Remoção*	2.03- Muros de divisa
100	679	NI	NI	*Não identificada (não coletada)*		*5,0*	*26,00*	*0,00*	*0,00*	*0,00*	*26,00*		*Remoção*	2.03- Muros de divisa
101	692	Pau-incenso	Pittosporaceae	*Pittosporum undulatum*	*Exótica*	*5,0*	*11,00*	*0,00*	*0,00*	*0,00*	*11,00*		*Remoção*	2.03- Muros de divisa
102	696	Gongonha	Cardiopteridaceae	*Citronella gongonha*	*Nativa*	*7,0*	*10,00*	*0,00*	*0,00*	*0,00*	*10,00*		*Remoção*	2.03- Muros de divisa
103	697	Sibipiruna	Fabaceae	*Caesalpinia pluviosa*	*Exótica*	*9,0*	*27,00*	*0,00*	*0,00*	*0,00*	*27,00*		*Remoção*	2.03- Muros de divisa
104	698	NI	NI	*Não identificada (não coletada)*		*10,0*	*19,00*	*0,00*	*0,00*	*0,00*	*19,00*		*Remoção*	2.03- Muros de divisa
105	700	Almecegueira	Burseraceae	*Protium spruceanum*	*Nativa*	*7,0*	*11,00*	*0,00*	*0,00*	*0,00*	*11,00*		*Remoção*	2.03- Muros de divisa
106	721	Açoita cavalo	Luehea	*Luehea sp*	*Nativa*	*7,0*	*14,00*	*0,00*	*0,00*	*0,00*	*14,00*		*Remoção*	2.03- Muros de divisa
107	724	Açoita cavalo	Luehea	*Luehea sp*	*Nativa*	*8,0*	*30,00*	*0,00*	*0,00*	*0,00*	*30,00*		*Remoção*	2.03- Muros de divisa
108	725	Açoita cavalo	Luehea	*Luehea sp*	*Nativa*	*10,0*	*20,00*	*0,00*	*0,00*	*0,00*	*20,00*		*Remoção*	2.03- Muros de divisa
109	726	NI	NI	*Não identificada (não coletada)*		*10,0*	*23,00*	*0,00*	*0,00*	*0,00*	*23,00*		*Remoção*	2.03- Muros de divisa
110	727	NI	NI	*Não identificada (não coletada)*		*10,0*	*23,00*	*0,00*	*0,00*	*0,00*	*23,00*		*Remoção*	2.03- Muros de divisa
111	733	Macucurana-cinzeiro	Chrysobalanaceae	*Hirtella hebeclada*	*Nativa*	*5,0*	*12,00*	*11,00*	*11,00*	*0,00*	*19,65*		*Remoção*	2.03- Muros de divisa
112	743	NI	NI	*Não identificada*		*9,0*	*9,00*	*0,00*	*0,00*	*0,00*	*9,00*		*Remoção*	2.03- Muros de divisa
113	753	Porangaba	Boraginaceae	*Cordia ecalyculata*	*Nativa*	*9,0*	*20,00*	*0,00*	*0,00*	*0,00*	*20,00*		*Remoção*	2.03- Muros de divisa
114	754	Cafezinho-do-mato	Celastraceae	*Maytenus floribunda*	*Nativa*	*8,0*	*9,00*	*0,00*	*0,00*	*0,00*	*9,00*		*Poda*	2.03- Muros de divisa
115	808	Falsa-seringueira	Moraceae	*Ficus elastica var. decora*	*Exótica*	*10,0*	*80,00*	*0,00*	*0,00*	*0,00*	*80,00*		*Observar*	2.03- Muros de divisa
116	809	NI	NI	*Não identificada*		*5,0*	*10,00*	*0,00*	*0,00*	*0,00*	*10,00*		*Remoção*	2.03- Muros de divisa
117	814	Abacateiro	Lauraceae	*Persea gratissima*	*Exótica*	*12,0*	*14,00*	*0,00*	*0,00*	*0,00*	*14,00*		*Observar*	2.03- Muros de divisa
118	816	Abacateiro	Lauraceae	*Persea gratissima*	*Exótica*	*8,0*	*16,00*	*0,00*	*0,00*	*0,00*	*16,00*		*Remoção*	2.03- Muros de divisa
119	375	NI	NI	*Não identificada (não coletada)*		*7,0*	*16,00*	*0,00*	*0,00*	*0,00*	*16,00*		*Remoção*	2.04- Infra estrutura
120	6	Pau Jacaré	Fabaceae	*Piptadenia gonoacantha*	*Nativa*	*9,0*	*38,00*	*0,00*	*0,00*	*0,00*	*38,00*		*Poda*	2.04- Infraestrutura
121	56	Abacateiro	Lauraceae	*Persea gratissima*	*Exótica*	*8,5*	*20,00*	*0,00*	*0,00*	*0,00*	*20,00*		*Remoção*	2.04- Infraestrutura
122	57	Jambeiro	Myrtaceae	*Syzygium jambos*	*Exótica*	*6,5*	*14,00*	*0,00*	*0,00*	*0,00*	*14,00*		*Remoção*	2.04- Infraestrutura
123	70	NI	NI	*Não identificada (não coletada)*		*1,5*	*10,00*	*0,00*	*0,00*	*0,00*	*10,00*		*Remoção*	2.04- Infraestrutura
124	106	Abacateiro	Lauraceae	*Persea gratissima*	*Exótica*	*8,0*	*31,00*	*0,00*	*0,00*	*0,00*	*31,00*		*Remoção*	2.04- Infraestrutura
125	107	Guaçatonga	Flacourtiaceae	*Casearia sylvestris*	*Nativa*	*7,5*	*30,00*	*0,00*	*0,00*	*0,00*	*31,00*		*Remoção*	2.04- Infraestrutura
126	119	Almecegueira	Burseraceae	*Protium heptaphyllum*	*Nativa*	*7,0*	*14,00*	*7,00*	*0,00*	*0,00*	*15,65*		*Remoção*	2.04- Infraestrutura
127	151	Tipuana	Fabaceae	*Tipuana tipu*	*Exótica*	*12,0*	*46,00*	*70,00*	*0,00*	*0,00*	*83,76*		*Remoção*	2.04- Infraestrutura
128	156	Abacateiro	Lauraceae	*Persea gratissima*	*Exótica*	*9,0*	*23,00*	*0,00*	*0,00*	*0,00*	*23,00*		*Remoção*	2.04- Infraestrutura
129	158	Pau-ferro	Fabaceae	*Caesalpinia leiostachya*	*Nativa*	*9,0*	*9,00*	*0,00*	*0,00*	*0,00*	*9,00*		*Remoção*	2.04- Infraestrutura
130	166	Mangueira	Anacardiaceae	*Mangifera indica*	*Exótica*	*6,0*	*22,00*	*0,00*	*0,00*	*0,00*	*22,00*		*Remoção*	2.04- Infraestrutura
131	199	Camboatá-vermelho	Sapindaceae	*Cupania vernalis*	*Nativa*	*3,0*	*10,00*	*0,00*	*0,00*	*0,00*	*10,00*		*Remoção*	2.04- Infraestrutura
132	203	Almecegueira	Burseraceae	*Protium heptaphyllum*	*Nativa*	*20,0*	*7,50*	*0,00*	*0,00*	*0,00*	*7,50*		*Remoção*	2.04- Infraestrutura
133	204	Almecegueira	Burseraceae	*Protium heptaphyllum*	*Nativa*	*17,0*	*7,50*	*0,00*	*0,00*	*0,00*	*7,50*		*Remoção*	2.04- Infraestrutura
134	218	NI	NI	*Não identificada*		*8,0*	*18,00*	*18,00*	*0,00*	*0,00*	*25,46*		*Remoção*	2.04- Infraestrutura
135	254			*Morta*		*5,0*	*35,00*	*0,00*	*0,00*	*0,00*	*35,00*		*Remoção*	2.04- Infraestrutura

Nº Item	Nº da plaqueta	Nome popular	Família botânica	Nome científico	Origem	Altura total	DAP1	DAP2	DAP3	DAP4	∑ Do diâmetro quadrático	Estado fitossanitário	Manejo pretendido	Categoria de manejo/ interferência
136	332			*Não identificada (não coletada)*		*8,0*	*23,00*	*0,00*	*0,00*	*0,00*	*23,00*		*Remoção*	2.04- Infraestrutura
137	340	Maytenus	Celastraceae	*Maytenus robusta*	*Nativa*	*11,0*	*42,00*	*0,00*	*0,00*	*0,00*	*42,00*		*Remoção*	2.04- Infraestrutura
138	344	Figueira	Moraceae	*Ficus aff. Guaranitica*	*Nativa*	*6,0*	*17,00*	*0,00*	*0,00*	*0,00*	*17,00*		*Remoção*	2.04- Infraestrutura
139	347	NI	NI	*Não identificada (não coletada)*		*8,0*	*15,00*	*0,00*	*0,00*	*0,00*	*15,00*		*Remoção*	2.04- Infraestrutura
140	350	Amaioua	Rubiaceae	*Amaioua Guianensis*	*Nativa*	*6,0*	*10,00*	*0,00*	*0,00*	*0,00*	*10,00*		*Remoção*	2.04- Infraestrutura
141	377			*Arvore Seca*		*2,0*	*32,00*	*0,00*	*0,00*	*0,00*	*32,00*		*Remoção*	2.04- Infraestrutura
142	392	Capororoca	Primulaceae	*Rapanea umbellata*	*Nativa*	*8,0*	*10,00*	*0,00*	*0,00*	*0,00*	*10,00*		*Remoção*	2.04- Infraestrutura
143	460	NI	NI	*Não identificada (não coletada)*		*15,0*	*55,00*	*0,00*	*0,00*	*0,00*	*55,00*		*Remoção*	2.04- Infraestrutura
144	462	Abacateiro	Lauraceae	*Persea gratissima*	*Exótica*	*10,0*	*30,00*	*0,00*	*0,00*	*0,00*	*30,00*		*Remoção*	2.04- Infraestrutura
145	464	Jerivá	Arecaceae	*Syagrus romanzoffiana*	*Nativa*	*10,0*	*20,00*	*0,00*	*0,00*	*0,00*	*20,00*		*Remoção*	2.04- Infraestrutura
146	533		Fabaceae	*Andira sp.*	*Nativa*	*12,0*	*43,00*	*0,00*	*0,00*	*0,00*	*43,00*		*Remoção*	2.04- Infraestrutura
147	534	Pera-glabrata	Peraceae	*Pera glabrata*	*Nativa*	*6,0*	*10,00*	*0,00*	*0,00*	*0,00*	*10,00*		*Remoção*	2.04- Infraestrutura
148	541		Myrtaceae	*Não identificada (não coletada)*	*Nativa*	*8,0*	*8,00*	*0,00*	*0,00*	*0,00*	*8,00*		*Remoção*	2.04- Infraestrutura
149	633	Jerivá	Arecaceae	*Syagrus romanzoffiana*	*Nativa*	*15,0*	*36,00*	*0,00*	*0,00*	*0,00*	*36,00*		*Poda*	2.04- Infraestrutura
150	705	Almecegueira	Burseraceae	*Protium heptaphyllum*	*Nativa*	*8,0*	*17,00*	*0,00*	*0,00*	*0,00*	*17,00*		*Remoção*	2.04- Infraestrutura
151	707	Pau-incenso	Pittosporaceae	*Pittosporum undulatum*	*Exótica*	*8,0*	*16,00*	*0,00*	*0,00*	*0,00*	*16,00*		*Remoção*	2.04- Infraestrutura
152	709	NI	NI	*Não identificada*		*8,0*	*20,00*	*0,00*	*0,00*	*0,00*	*20,00*		*Remoção*	2.04- Infraestrutura
153	719	NI	NI	*Não identificada (não coletada)*		*4,0*	*11,00*	*0,00*	*0,00*	*0,00*	*11,00*		*Remoção*	2.04- Infraestrutura
154	788	Almecegueira	Burseraceae	*Protium heptaphyllum*	*Nativa*	*9,0*	*30,00*	*10,00*	*10,00*	*0,00*	*33,17*		*Remoção*	2.04- Infraestrutura
155	792	Painera-rosa	Bombacaceae	*Chorisia speciosa*	*Nativa*	*12,0*	*53,00*	*0,00*	*0,00*	*0,00*	*53,00*		*Remoção*	2.04- Infraestrutura
156	796	Cafezinho-do-mato	Celastraceae	*Maytenus robusta*	*Nativa*	*6,0*	*12,00*	*0,00*	*0,00*	*0,00*	*12,00*		*Remoção*	2.04- Infraestrutura
157	490	Seafórtia	Arecaceae	*Archontophoenix cunninghamiana*	*Nativa*	*8,0*	*22,00*	*0,00*	*0,00*	*0,00*	*22,00*		*Remoção*	2.05- Relev. Ambiental/ invasora
158	575	Seafórtia	Arecaceae	*Archontophoenix cunninghamiana*	*Nativa*	*21,0*	*10,00*	*0,00*	*0,00*	*0,00*	*10,00*		*Remoção*	2.05- Relev. Ambiental/ invasora
159	639	Seafórtia	Arecaceae	*Archontophoenix cunninghamiana*	*Nativa*	*6,0*	*8,00*	*0,00*	*0,00*	*0,00*	*36,00*		*Remoção*	2.05- Relev. Ambiental/ invasora

Management Plan of the Tree Vegetation and low retaining walls, stairs and ramps damages. Sheet 1

1
Management Plan of the Tree Vegetation

- Interference between tree vegetation and boundary walls
- Interference between tree vegetation and garden infrastructure
- Interference between tree vegetation and garden environments
- Interference between tree vegetation and buildings
- The environmental relevance of tree species vs. its phytosanitary status and potential for biological invasion
- Tree to be suppressed by shallow felling
- Tree to be pruned for crown rebalancing

2
Low retaining walls, stairs and ramps damages

- (43) see numbered photos as indicated

3
External elevated tubes

Code	Component	Description	Diagnosis	Identified pathology	Orientations
PA. 01.03	low retaining walls in the garden	Low retaining walls of brick, stonework, mortar finishing on the exterior with incrusted pebbles, shards of ceramic and sandstone.	Damages ranging from light cracks to the partial decay of the retaining walls in some sections. Inclined trees and exposed roots overburden the walls.		Trees at risk of falling should be removed according to the diagnosis of the landscapers in the general plan. Reassess the situation after their removal. In some cases, new retaining walls should be constructed within the existing wall to interrupt the degradation. In others, it is necessary to choose between interrupting the ruin or erecting a new wall, appearing clearly as not an original construction.

1

Light crack in the stair wall

2

Interference of external elevated water tubes over the vegetable gardens.

3,4,5

Damages in the vegetable garden walls

6

Light crack in the low retaining wall

10

Light crack in low retaining wall due to tree growth

Code	Component	Description	Diagnosis	Identified pathology	Orientations
PA. 01.02	retaining wall of reinforced concrete under the ovens	Retaining wall under platform at the back of the house, where the oven and grill are located. Back-up reinforced concrete structure implemented after the original construction with the objective of preventing it from ruin.	Cracks and partial decay in the retaining walls. Contention previously achieved with the fastening of stay cables to the wall which does not entirely impede the continuing risk of ruin. The inclination of the wall warns of the risk of collapse.		Remove the bushes and dirt against the wall in order to evaluate the structure's integrity. If necessary, construct a new internal contention wall, thus relieving the pressure on the original inclined wall.

13

Assembly view of retaining wall and landing where the wood-burning oven and grill are placed.

14

View that allows us to understand the relationship between the retaining wall and the oven on the landing

15

Concrete top of the stay cables

17, 18

Water installation passes through the gap between the inclined retaining wall and the granite stone structure, indicating a stabilization of movement.

Code	Component	Description	Diagnosis	Identified pathology	Orientations
PA.02.01	external flooring on the garden walkways	Flooring comprised of irregular sandstone slabs, laid directly in the ground or on a small base of mortar.	Displacement of walkway slabs generates instability.		Reattach the stones with cement mortar. Those that happen to be in direct contact with the dirt should be removed. Excavate the dirt and reset the stone.

22

A stretch of wall with tree trunk and roots raising the red sandstone stones of the path

24

Destabilized route due to breakage and displacement of retaining wall and settlement of the stepping stones.

26

Retaining wall broken due to tree growth at the edge (dead tree)

29

View of the section of broken wall due to to tree growth on the edge (live tree)

30

Wall in the rupture process path interrupted by installation tubes of electricity, telephony and logic.

33 e 34

Ruined wal

35

Cold water pipe interrupting path. Floor
stone loose and shifted from its original position.

36

Wall cracked by the growth of the tree trunk.

37

Roots of the elastic Ficus tree forcing the stone floor of the pilotis area.

41

Crack in the edge of the retaining wall. Waterproof section to receive rainwater fall from the gargoyle

Management Plan of the Tree Vegetation and low retaining walls, stairs and ramps damages. Sheet 2

1
Management Plan of the Tree Vegetation

- Interference between tree vegetation and boundary walls
- Interference between tree vegetation and garden infrastructure
- Interference between tree vegetation and garden environments
- Interference between tree vegetation and buildings
- The environmental relevance of tree species vs. its phytosanitary status and potential for biological invasion
- Tree to be suppressed by shallow felling
- Tree to be pruned for crown rebalancing

2
Low retaining walls, stairs and ramps damages

- (43) see numbered photos as indicated

3
External elevated tubes

Trees over the garage, grown spontaneously. Proposed complete cut by interference with the building. 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566.

48

Roots raising path floors and damaging walls

44

Light crack in the low garden wall

49

Fall of a tree, producing damage to the path, low wall, external enclosure wall and public power grid. August 2017.

50

Trunk growth makes it difficult to pass through the path.

Management Plan of the Tree Vegetation and low retaining walls, stairs and ramps damages. Sheet 3

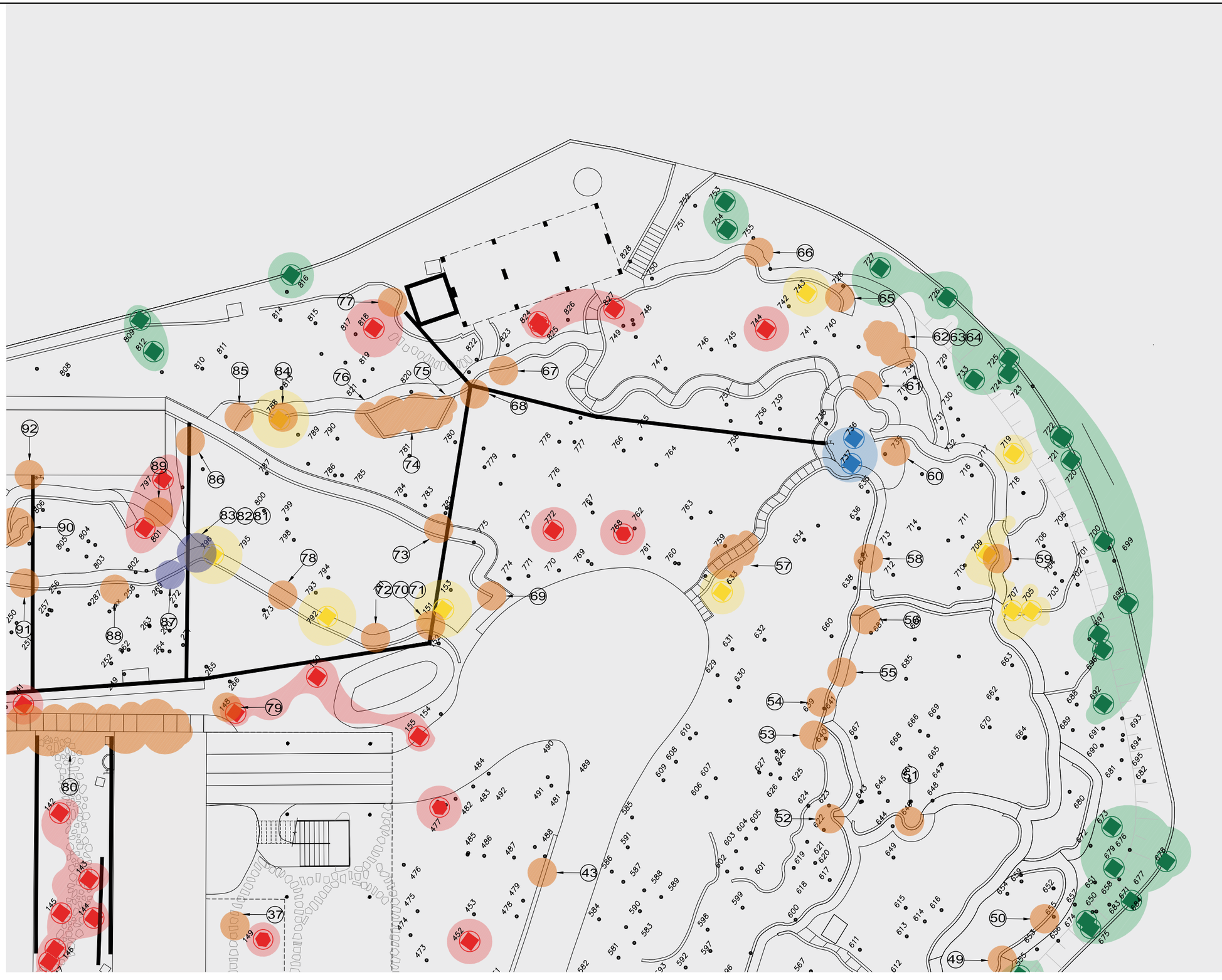
1
Management Plan of the Tree Vegetation

- Interference between tree vegetation and boundary walls
- Interference between tree vegetation and garden infrastructure
- Interference between tree vegetation and garden environments
- Interference between tree vegetation and buildings
- The environmental relevance of tree species vs. its phytosanitary status and potential for biological invasion
- Tree to be suppressed by shallow felling
- Tree to be pruned for crown rebalancing

2
Low retaining walls, stairs and ramps damages

- see numbered photos as indicated

3
External elevated tubes



59

Trunk dislocation still not damaging the low garden wall.

Tree (expected for complete pruning) fall over the studio.

62, 63, 64

Bamboo clump next to a low wall.

66

Damaged low wall.

Trees with interference in the boundary wall, provided for cutting. 723, 724, 725.

67

Root threatening the path.

A 827

Wall damaged by the fall of tree 827, expected for complete pruning.

A 824

Tree 827, scheduled for complete removal, supported on the eaves of the Studio.

74

Slightly damaged flooring and retaining wall

68 e 75

Interference of the cold water tube on path.

84

Tree 788, proposed for removal, interrupts path.

Trees in the region near the border wall with Rua Seguidilha, proposed for removal.

69, 70, 71

Stairway with isolated stones with the protection wall of the Vasca (front), tree 151 intended for complete cut.

79, 81, 82, 83

Destroyed paths and walls, interference from elevated tubes for electricity and telephone lines.
By the house one can evaluate the dimensions of the tree 148, proposed for full removal, conflict area 79 .

Management Plan of the Tree Vegetation and low retaining walls, stairs and ramps damages. Sheet 4

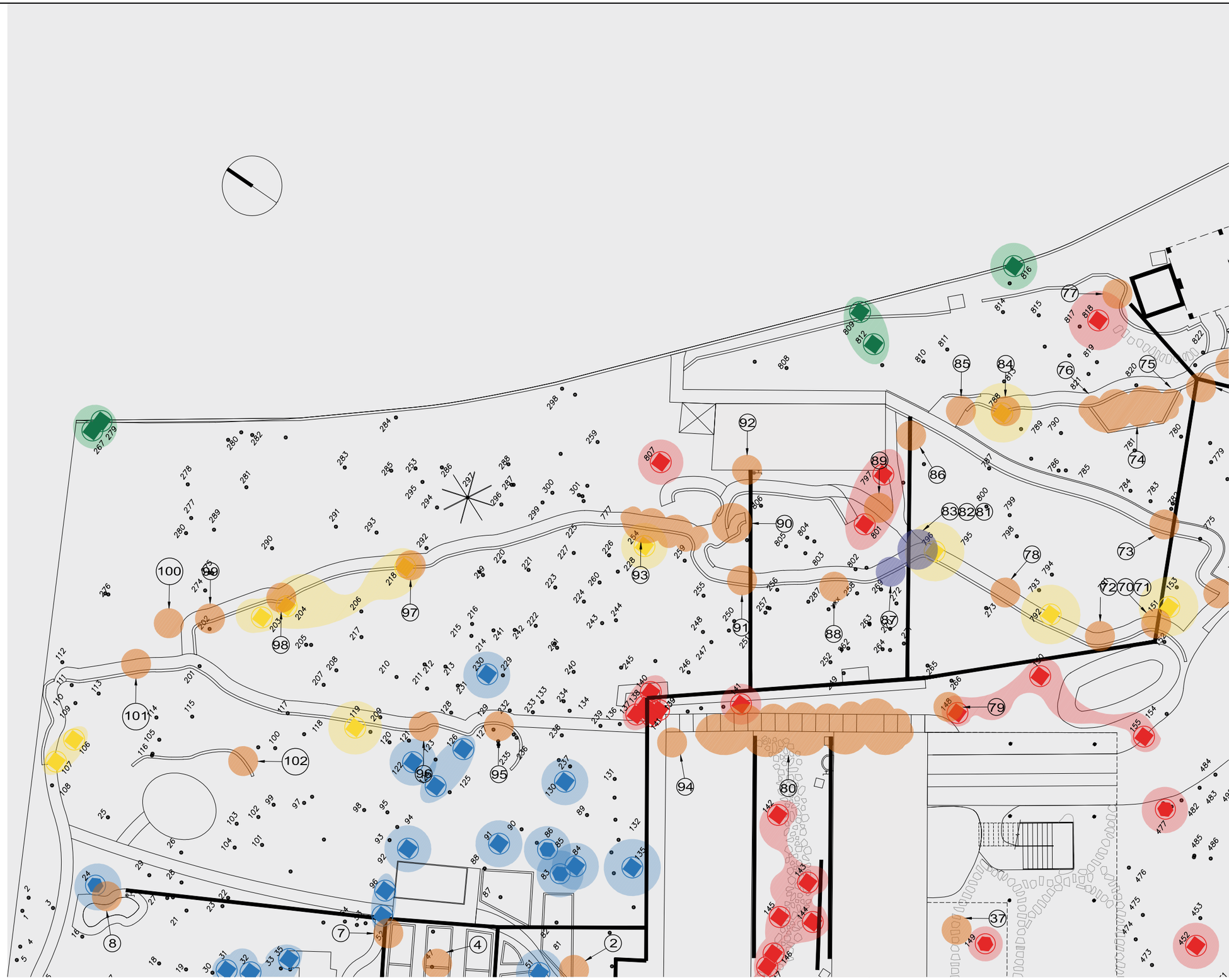
1
Management Plan of the Tree Vegetation

- Interference between tree vegetation and boundary walls
- Interference between tree vegetation and garden infrastructure
- Interference between tree vegetation and garden environments
- Interference between tree vegetation and buildings
- The environmental relevance of tree species vs. its phytosanitary status and potential for biological invasion
- Tree to be suppressed by shallow felling
- Tree to be pruned for crown rebalancing

2
Low retaining walls, stairs and ramps damages

- (43) see numbered photos as indicated

3
External elevated tubes



93

Long extension of destroyed retaining wall. Tree 254 proposed for removal due its interference with the infrastructure of the garden.

97, 98

Area at the back of the land, with great slope and several trees about to fall.

84

Tree 788, proposed for removal, interrupts path.

89

View from the trees above the caretaker's house on steep slope. Proposed complete cutting of trees 797 and 801.

94

Tree 127 (Persea americana - avocado) supported on the service area platband. Proposed removal by conflict with the building.

Tree 132 fall over the house service area, breaking tiles. Notice that the whole tree (with roots) has fallen

Garden visitation paths and support areas

Garden visitation paths
Captions of the difficulty degree of the paths

- Blue path
  Low difficulty
- Yellow path
  Medium difficulty
- Purple path
  High difficulty
- Red path
  High difficulty and obstructions

Areas selected for the green waste disposal system – composting and storage

- Storage
- Composting
- Position of selected tree specimens for visual communication
  See numbering indication in species identification table

Selected tree specimens
Educative signs

Item	Nº da plaqueta	Nome científico	Nome popular	Família botânica	Origem	Altura	DAP1	DAP2
1	5	Cupania vernalis	Camboatá-vermelho	Sapindaceae	nativa	6,00	8,00	10,00
2	7	Amaloua guinensis	Canela-de-veado	Rubiaceae	nativa	7,00	14,00	0,00
3	26	Cupania vernalis	Camboatá-vermelho	Sapindaceae	nativa	8,00	34,00	0,00
4	41	Alchoenea sp.	Pau-óleo	Euphobiaceae	nativa	7,50	18,00	0,00
5	45	Plinia cauliflora	Jaboticabeira	Myrtaceae	nativa	6,00	10,00	5,00
6	47	Schizolobium parahyba	Pixiricuçu	Fabaceae	nativa	12,00	30,00	0,00
7	55	Aspidosperma polyneuron	Peroba-rosa	Apocynaceae	nativa	9,50	21,00	0,00
8	60	Casearia decandra	Pau-de-espeto	Salicaceae	nativa	9,00	30,00	0,00
9	82	Hymenaea courbaril	Jatobá	Fabaceae	nativa	6,00	6,00	0,00
10	96	Alchoenea sp.	Pau-óleo	Euphobiaceae	nativa	8,00	20,00	0,00
11	107	Casearia sylvestris	Guaçatonga	Salicaceae	nativa	7,50	30,00	0,00
12	114	Maytenus floribunda	Cafezinho-do-mato	Celastraceae	nativa	7,00	10,00	0,00
13	120	Calyptranthes sp.	Guamirim-chorão	Myrtaceae	nativa	6,00	8,00	0,00
14	129	Maytenus sp.	-	Celastraceae	nativa	8,00	20,00	0,00
15	160	Caesalpinia pluviosa	Sibipiruna	Fabaceae	nativa	12,00	22,00	0,00
16	163	Andira legalis	Angelim doce	Fabaceae	nativa	7,00	13,00	0,00
17	169	Pera glabrata	Sapateiro	Peraceae	nativa	9,00	27,00	0,00
18	170	Guatteria nigrescens	Pindaiba-preta	Annonaceae	nativa	6,00	11,00	0,00
19	227	Handroanthus ochraceus	Ipê-do-cerrado	Bignniaceae	nativa	4,50	11,00	0,00
20	256	Syagrus romanzoffiana	Jerivá	Arecaceae	nativa	15,00	9,00	0,00
21	258	Schizolobium parahyba	Guapuruvu	Fabaceae	nativa	12,00	110,00	0,00
22	275	Copaifera langsdorffii	Copaiba	Caesalpiniaceae	nativa	8,00	12,00	0,00
23	283	Hyeronima alchorneoides	Licurana	Phyllanthaceae	nativa	7,00	15,00	5,00
24	481	Eriobotrya japonica	Nespera	Rosaceae	exótica	4,00	5,00	0,00
25	484	Eugenia uniflora	Pitanga	Myrtaceae	nativa	6,00	13,00	0,00
26	517	Ceiba speciosa	Paineira-rosa	Malvaceae	nativa	15,00	75,00	0,00
27	527	Balfourodendron riedellianum	Pau-marfim	Rutaceae	nativa	8,00	19,00	0,00
28	528	Ceiba speciosa	Paineira-rosa	Malvaceae	nativa	15,00	60,00	0,00
29	535	Luehea speciosa	Açoita-cavalo	Malvaceae	nativa	15,00	64,00	0,00
30	585	Caesalpinia leiostachya	Pau-ferro	Fabaceae	nativa	15,00	40,00	0,00
31	603	Eugenia brasiliensis	Grumixameia	Myrtaceae	nativa	7,00	7,00	0,00
32	609	Syzygium malaccense	Jambo	Myrtaceae	nativa	6,00	15,00	15,00

Item	Nº da plaqueta	Nome científico	Nome popular	Família botânica	Origem	Altura	DAP1	DAP2
33	631	Caesalpinia leiostachya	Pau-ferro	Myrtaceae	nativa	17,00	38,00	0,00
34	632	Artocarpus heterophyllus	Jaqueira	Moraceae	exótica	17,00	35,00	0,00
35	655	Caesalpinia pluviosa	Sibipiruna	Fabaceae	exótica	12,00	27,00	0,00
36	687	Ficus sp.	Figueira	Moraceae	nativa	7,00	19,00	0,00
37	735	Syagrus romanzoffiana	Jerivá	Arecaceae	nativa	9,00	21,00	0,00
38	751	Archontophoenix cunninghamiana	Seafórtia	Arecaceae	exótica	6,00	11,00	0,00
39	759	Guarea kunthiana	Peloteira	Mellaceae	nativa	6,00	23,00	0,00
40	764	Hirtella hebeciada	Macucurana-cinzeiro	Chrysobalanaceae	nativa	10,00	20,00	9,00
41	769	Peltophorum dubium	Cafístula	Fabaceae	nativa	7,50	20,00	0,00
42	771	Machaerium nyctitans	Jaracandá-com-espinho	Fabaceae	nativa	12,00	19,00	0,00
43	789	Syagrus romanzoffiana	Jerivá	Arecaceae	nativa	11,00	26,00	0,00

Location of stairs and ramps

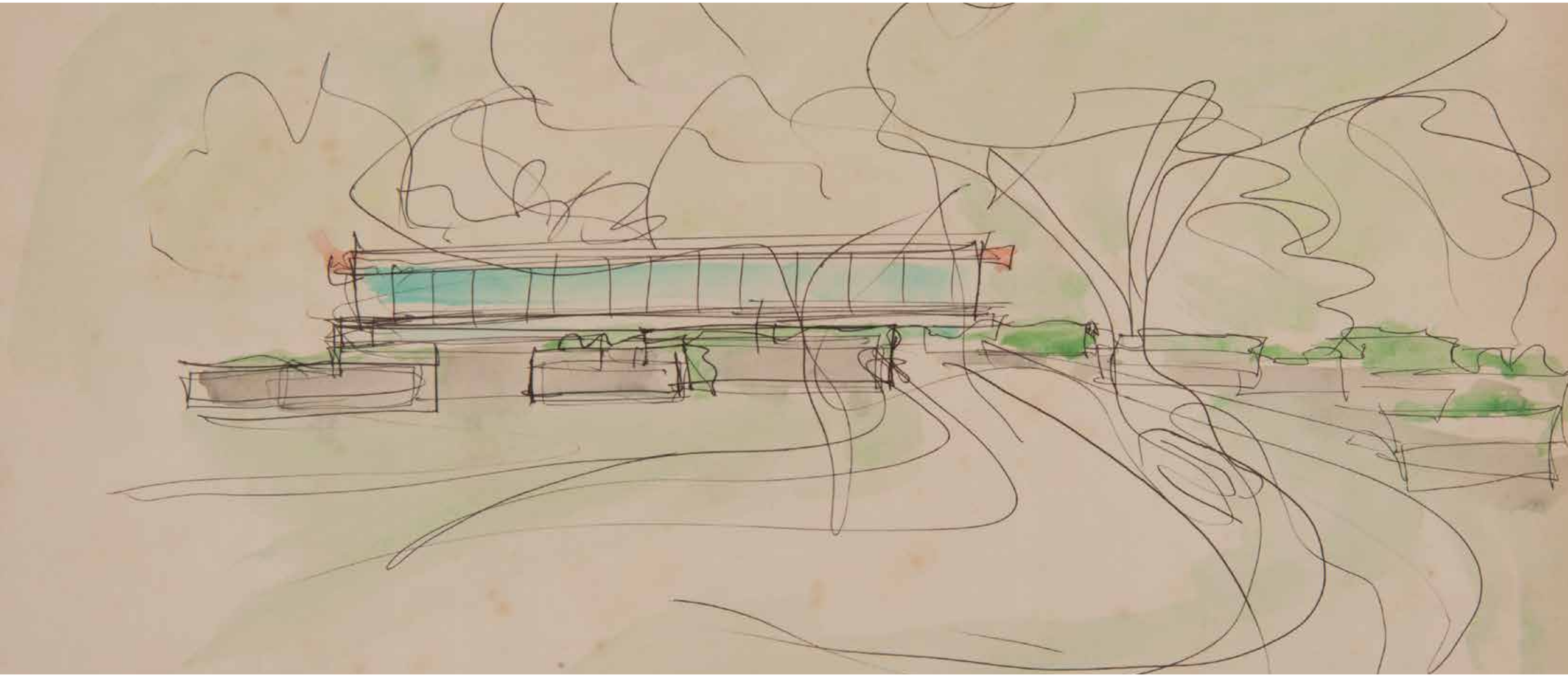
See descriptive table
on next page

Stairs

Ramps

Table of stairs and ramps

Item	**Denominação**	**Cota**				**Inclinação**		Classificação	Corrimão	Sinalização visual	Sinalização podotátil	Recomendações
Código		Base	Topo	Desnível	Compr	(%)	graus					
Escada 1 CV.03.02.05	Escada passeio externo da Casa de Vidro	112,4	115,4	3	15,36	20	10,5	Caminho com degraus	Não apresenta	Não apresenta	Não apresenta	Corrigir pontos de solapamento e refazer rejuntes
Escada 2 PA.02.01	Escada caminho de pedra	115,8	118,3	2,5	5	50	27	Dentro do intervalo para escada	Não apresenta	Não apresenta	Não apresenta	Reassentamento dos degraus de pedra soltos, realizar drenagem ao longo do trecho e instalar corrimão
Escada 3 PA.02.03	Escada	116	117,2	1,2	1,95	62	33,2	Dentro do intervalo para escada	Não apresenta	Não apresenta	Não apresenta	Apesar da recomendação, a instalação de corrimão descaracteriza o bem tombado
Escada 4 PA.02.01	Escada caminho de pedra	114,9	117	2,1	7,6	28	14,9	Caminho com degraus	Não apresenta	Não apresenta	Não apresenta	Reassentamento dos degrausde pedra soltos, realizar drenagem ao longo do trecho e instalar corrimão
Escada 5 PA.02.01	Escada caminho de pedra	114,9	115,7	1,1	2,2	50	27	Dentro do intervalo para escada	Não apresenta	Não apresenta	Não apresenta	Apesar da recomendação, a instalação de corrimão descaracteriza o bem tombado
Escada 6 CV.03.02.05	Escada passeio externo da Casa de Vidro	114,3	116	1,7	5,5	31	16,7	Caminho com degraus	Não apresenta	Não apresenta	Não apresenta	Corrigir pontos de solapamento e refazer rejuntes
Escada 7 PA.02.01	Escada caminho de pedra	112,3	114,3	2	5,5	36	19,6	Caminho com degraus	Não apresenta	Não apresenta	Não apresenta	Reassentamento dos degraus de pedra soltos
Escada 8 PA.02.01	Escada caminho de pedra	108,7	110,1	1,4	3,4	41	22,2	Caminho com degraus	Não apresenta	Não apresenta	Não apresenta	Reassentamento dos degraus de pedra soltos
Escada 9 PA.02.01	Escada caminho de pedra	103,5	112,2	8,7	22,45	39	20,9	Caminho com degraus	Não apresenta	Não apresenta	Não apresenta	Reassentamento dos degraus de pedra soltos
Escada 10	Escada entrada do estúdio	95,8	97,5	1,7	3,3	52	27,8	Dentro do intervalo para escada	Não apresenta	Não apresenta	Não apresenta	Instalação de corrimão de seção cilíndrica dentro do padrão de altura (90cm 72 cm)
Escada 11 PA.02.01 e PA.02.02	Escada caminho do estúdio	97,5	103,7	6,2	26,54	23	12,6	Caminho com degraus	Apresenta	Não apresenta	Não apresenta	Apesar da recomendação, a instalação de corrimãocilídrico descaracteriza o bem tombado
Escada 12 PA.02.01 e PA.02.02	Escada caminho do estúdio	103,9	108,6	4,7	12,85	37	19,8	Caminho com degraus	Apresenta	Não apresenta	Não apresenta	Apesar da recomendação, a instalação de corrimãocilídrico descaracteriza o bem tombado
Escada 13 PA.02.01 e PA.02.02	Escada caminho da casa do caseiro	101	105,5	4,5	6,5	69	37,4	Dentro do intervalo para escada	Não apresenta	Não apresenta	Não apresenta	Apesar da recomendação, a instalação de corrimãocilídrico descaracteriza o bem tombado
Escada 14 PA.02.01	Escada caminho da casa do caseiro	99,75	102,8	3,05	8,05	38	20,5	Caminho com degraus	Apresenta	Não apresenta	Não apresenta	Reassentamento dos degraus de pedra soltos
Escada 15 PA.02.01	Escada caminho de pedra	102,2	108,9	6,7	23,9	28	15,1	Caminho com degraus	Não apresenta	Não apresenta	Não apresenta	Reassentamento dos degraus de pedra soltos
Escada 16 PA.02.01	Escada caminho de pedra	97,7	100,48	2,78	12,6	22	11,9	Caminho com degraus	Não apresenta	Não apresenta	Não apresenta	Reassentamento dos degraus de pedra soltos
Escada 17 PA.02.01	Escada caminho de pedra	99,16	100,2	1,04	7,1	15	7,9	Caminho com degraus	Não apresenta	Não apresenta	Não apresenta	Reassentamento dos degraus de pedra soltos
Escada 18 PA.02.01	Escada caminho de pedra	99,2	102,64	3,44	17,1	20	10,9	Caminho com degraus	Não apresenta	Não apresenta	Não apresenta	Reassentamento dos degraus de pedra soltos
RAMPA 1 PA.02.04	Rampa para veículos	100,2	108,1	7,9	44,45	18	9,6	Rampa muito íngreme, fora do recomendado	Não apresenta	Não apresenta	Não apresenta	Elemento original da casa, não pode ser alterado. Alternativas: uso de veículo elétrico, autorizar acesso do veículo do visitante, construír sistema em outra posição.



4.1 Declaration of Cultural Significance

The main importance of the Casa de Vidro [Glass House] is its modern aesthetic conception, which guides all its design decisions. Representing the modern architecture produced in Brazil in the 1950s, the work stands out for the spatial continuity between interior and exterior, which provides spatial integration with the surrounding tropical garden. The absence of brises soleil protection highlights the transparency of floor-to-ceiling glass frames, while the structure and floor colors of sky-blue glass inserts accentuate spatial continuity.

The room is a platform raised from the ground which is supported by thin cylindrical pillars. In it, the arrangement of the collection of works of art and furniture, from different origins and times, is a record of an expographic experiment that would feed the project of the second headquarters of the Museum of Art of São Paulo (Masp). The contrast between the high transparent room and the opaque volumes of ground-based white masonry is another relevant feature of the architectural ensemble.

The intense tropical garden sets it apart from other works with glazed facades of the same period. Inexistent at the time of the project, the garden was conceived along with the architecture, planted and worked by the couple in their daily lives. The garden situates the abstract and international architecture of the Casa de Vidro in tropical Brazil.

The three existing annexes, as well as the retaining walls, garden walls, stone pathways and staircases were built on different principles from those of the main house. They note the transformations the architect has gone through in her life: from an international architecture, in the main house and in the caretaker's house, she approached the organicism in the garage, reaching an interpretation of popular architecture in the studio. These constructions carry different degrees of aesthetic importance, but all of them contribute to the historical narrative of the couple's trajectory in Brazil.

The Casa de Vidro has the historical importance of having been the home of the Italian couple Lina Bo and Pietro Maria Bardi, who arrived in Brazil in 1946. It contains their contributions to the Brazilian intellectual formation, in particular to art, architecture, design and to museology. It keeps the couple's main collection of documents, as well as their collection of objects of art, popular culture and design. Thus, it is the shelter of a collection of international importance for research in the area of art history and architecture, and its structure and equipment must be constantly updated.

Preserved at the municipal (Conpresp), state (Condephaat) and federal (Iphan) levels as an initiative of the Bardi couple, the Casa de Vidro and its collection have relevant cultural value for contemporary times. Concomitantly with their preservation, the couple created the Quadrante Institute, now known as the Bardi Institute. Its main mission is to manage the conservation of the house and make its architecture, collection and garden accessible to the public. Since then, the Bardi Institute stands out as an example of preservation of private cultural heritage in the country. Position that allows it to share its experience with other institutions, aiming at the production of preservationist and educational policies in this area.

In addition to preserving the Casa de Vidro, the Bardi Institute has cultural and artistic goals and can promote exhibitions, courses, conferences and even grants for the production of artists, architects and art and architecture historians. The Casa de Vidro, its garden and collection attract the interest of a wide audience, which demands that it be equipped accordingly in order to welcome them without conflicts with its preservation and with the research and training activities promoted by the Bardi Institute. The adaptation or construction of new areas to support these activities must be done in a manner that is compatible with the preservation of the main features of architecture and landscaping.

The preservation of the Casa de Vidro is inseparable from the mission of the Bardi Institute, being both legacies of the couple Lina and Pietro Maria Bardi.

4.2 Significance Matrix

		Aesthetic Value	Historical Value	Authenticity	Irreplaceability Degree	General Significance
Main House		Exceptional	Exceptional	High (underwent renovations that maintained its set)	High	Exceptional
	Living Room	Exceptional	Exceptional	High	High	Exceptional
	Bedrooms sector	High	Medium	Medium	Medium	High
	Kitchen	High	High	High	High	High
	Service	Low	Low	Low	Low	Low
	Pilotis	Exceptional	Exceptional (steel cylindrical pilotis did not exist in Brazilian architecture)	Exceptional	High	Exceptional
	Roof and Gutters	High (curved cover profile)	Medium	None (already replaced)	None (with the exception of front gargoyles)	Medium
	Garden roof	High	High	Medium	Medium	Medium
	Glazing pockets of the living room	Exceptional	Exceptional	Medium (various interventions due to oxidation)	Medium	Exceptional
	Glass on the living room	Exceptional	High	None (already replaced)	None	Exceptional
	Windows frames	High	High	Medium	Medium	High
	Vidrotil coating	Exceptional	Exceptional	Exceptional	Exceptional (no longer manufactured)	Exceptional
Studio		High	High	High	Medium	High
	External seal	High	High	Medium (some panels have been replaced)	Low (panels in production)	High
	Wood structure	High	High	High	Medium	High
	Wood planks of the floor	Medium	Medium	Medium	Low	High
	Hydraulic module	High	High	High	Low	Medium
	Garden roof	High	Medium	High	Low	High
Garage		High	Medium	High	Medium	High
	Garden roof	High	High	Medium (mishandling)	Low (needs management)	High (remarkable presence in the set)
	External seal	High	High	High	High	High
	Gate	Medium	Medium	Medium (has already suffered several interventions to make it work)	Low (as long as the external appearance is maintained)	Medium
	Interior	Low	Low	Low	Low	Low
Caretaker's House		Low	Low	Low	Low	Low
	Garden roof	High	High	Low (much maintenance)	Low	High (high exposure in the set)
	External seal	Medium	Medium	Low	Low	Low
	Glazing pockets	Low	Low	Low	Low	Low (do not interfere with the set)
	Interior	Low	Low	Low	Low	Low

		Aesthetic Value	Historical Value	Authenticity	Irreplaceability Degree	General Significance
Garden		High	High	Medium	Medium	High
	Paths, stairs and ramps	High	Medium	High	Medium (needs maintenance)	High
	Retaining walls	High	Medium	High	High	High
	Walls	High	Medium	High	High	High
	Living floors	Medium	Medium	High	Medium	High
	Vascas	High	High	High	High	High
	Oven and barbecue	High	High	High	High	High
	Tree vegetation	High	Medium	Medium (unmanaged growth)	Medium	High
	Undergrowth vegetation	Medium	Medium	Low (many species disappeared with shade from growing trees)	Low	Medium
Collection		Exceptional	Exceptional	Exceptional	Exceptional	Exceptional
Fundo Lina Bo Bardi	Writings, drawings, photos of works, videos	Exceptional	Exceptional	Exceptional	Exceptional	Exceptional
Fundo Pietro Maria Bardi	Writings, publications, collections	Exceptional	High (incomplete)	Exceptional	Exceptional	High (part of the documents are in the Masp Library, another part in the Trivulsiana Library in Milan)
Collection of works of art	Historical paintings, sculptures, artifacts and furniture	High	High (incomplete)	Exceptional	High	High (an important part of the works was removed by the heirs of Pietro M. Bardi)
Library	Books purchased by the couple Bardi	High	High (incomplete)	Exceptional (books with notes on its margins)	Exceptional	High (an important part of the books was donated to the Masp Library)

4.3 Conservation Management Policy

Plan of Goals, Actions and Projects

Goal 1
Preserve the modern aesthetic integrity of the Casa de Vidro as an example that stands out amidst the vast array of modern architecture produced in Brazil in the 1950s.

Goal 2
Preserve the attached buildings (Caretaker's House, Garage and Studio) as a testimony to the transformations in the Bardi couple's architectural and cultural conceptions.

Goal 3
Make the garden enjoyable for visitors, seeing it not just as a complement to architecture.

Goal 4
Institutional: Consolidate its use as a house museum, headquarters of the Bardi Institute, with a significant collection which consists of the personal documents of the couple Lina and Pietro Maria Bardi and their collection of works of art.

Goal 5
Provide the Casa de Vidro with facilities, infrastructure and routines suitable for its use as a cultural institution and as a listed historical heritage site.

Goal 6
Plan new buildings and expand the urban / social insertion of the Casa de Vidro.

Goal 1

Preserve the modern aesthetic integrity of the Casa de Vidro as an example that stands out amidst the vast array of modern architecture produced in Brazil in the 1950s.

Description:
The exceptionality of the set of buildings is due to the spatial continuity between interior and exterior, constituted by the full transparency of the room, raised from the ground, which integrates the domestic experience, the collection of works of art and the tropical garden planted by the couple. The contrast between the transparency of the high glazed room and the opacity of the floor-mounted volumes is a striking feature of the ensemble.

The essential components to maintain this aesthetic quality are:

1
whole window frames from floor to ceiling;
2
slimness of cylindrical pillars and floor and roof slabs in the living room area;
3
lightness and transparency of the access ladder;
4
lightness of the sky-blue floor used;
5
arrangement of furniture and artwork in the living room;
6
visual and spatial continuity with the surrounding tropical garden.

Action 1

Ensure full transparency of floor-to-ceiling framed glass.

Associated projects:

1
Replace the room's windows with safety models that are impact resistant and that ensure the protection of the works of art.
Urgency: selection and approval of the type of glass to be adopted – laminated, with protection against ultraviolet rays;
– approval of such replacement from the historical heritage preservation agencies: Conpresp, Condephaat and Iphan;
– donation or discount agreement with the glass manufacturer;
– planning of the implementation together with the adequacy of the frames;
– preparation of the partial interdiction of the house during the works;
– planning the transfer of the Institute's activities to other areas of the plot during the works;
– development of specific educational activities during the works.
Urgency: short term

2
Maintenance of frames and glazing pockets to prevent oxidation.
– maintenance of frames and glazing pockets, removing oxidation and installing anti-corrosion device (see Inventory);
– project and install devices to absorb the expansion of the structure, avoiding transmission to the glasses (see Inventory).
Urgency: short term

3
Elimination of risk of impact on glass.
– implement a tree management plan for pruning and cutting those closest to the frames (see Landscape project);
– train employees to avoid impacts during cleaning and house maintenance.
Urgency: emergency

Action 2

Ensure the integrity of the tubular columns.

Associated project:

Periodic maintenance of metal columns in order to eliminate surface corrosion.
– cleaning, with chemical removal of oxidation; removal of the old painting; application of antioxidant protection background and epoxy paint in original color;
– evaluate every six months the emergence of new oxidation points.
Urgency: short term

Action 3

Preserve the structural performance of floor and roof slabs to maintain their slimness.

Associated project:

1
Preservation of the side and bottom coverings of the floor slab.
– observe the emergence of signs of oxidation;
– observe the appearance of efflorescence, cracks, detachment of plaster and painting;
– correct pathologies, when they occur, by removing loose material and reconstituting the mortar;
– annual painting with whitewash.
Urgency: recommendation

2
Recovery of the watertightness of the cover and its preservation.
– replacement of all asbestos cement tiles, due to their toxic character, with new generation fiber cement model (see Inventory CV.03.04.01);
– removal of glass wool and cleaning of the slab;
– coat the rails internally with self-adhesive aluminized asphalt blanket (see Inventory CV.03.04.03);
– install semi-spherical drains at the inlets of rainwater pipe;
– carry out maintenance of channel flashing and chimneys;
– observe the appearance of moist points.
Urgency: emergency

Action 4

Recover the integrity of the garden roof on the kitchen.

Associated projects:

1
Removal of the water tank and boiler over the garden roof (linked to the construction of the new external water tank – Goal 6, Action 3).
– removal of water tank, boiler, substructure and distribution piping;
– recomposition of the support points of the substructure removed in the slab.

Urgency: mid-term

2
Recovering of the tightness of the garden roof.
– remove grass and mandacaru and preserve it for replanting;
– remove the soil and evaluate the conservation status of the waterproofing;
– redo the waterproofing with the same system for all garden roofs (Caretaker's House, Garage, Studio);
– redo the top of the disabled chimney and make new waterproofing;
– reconstitution of the original landscaping documented in the period photos.

Urgency: mid-term

Action 5

Maintain the lightness and transparency of the main staircase.

Associated projects:

1
Maintenance of the ladder structure.
– cleaning, paint and oxidation removal;
– painting with antioxidant layer;
– follow the development of the structure's arrow and develop new studies if it increases.

Urgency: mid-term

2
Study alternatives to the escape route in the Fire Safety Plan (linked to the Goal 6, Action 2).
– request special procedures for the processes at the Fire Department and at the Municipal Permanent Commission of Accessibility, as what is at stake is a heritage site;
– elaborate a plan with another escape route that dispenses with the suitability of the ladder.

Urgency: short term

Action 6

Maintenance of floors in Vidrotil tessellation.

Associated projects:

Careful maintenance of Vidrotil floors, ensuring the material replacement in the future when necessary.
– perform periodic cleaning;
– redo grouts when damaged;
– avoid point charges;
– locate and purchase product stock to ensure future replacement.

Urgency: recommendation

Action 7

Arrange furniture and artwork in the living room to ensure the continuity of the space.

Associated projects:

1
Make graphic pieces that provide clear instructions for furniture layout and artwork inside the house.

– living and dining room;
  – try to dispose the furniture in accordance with the existing arrangement shortly after Pietro Maria Bardi's death, saving room for furniture removed after the sharing. These spaces can be filled with replicas or analogous volumes.
– room – research area and library;
  – restructure the library, separating the books in the collection from the titles later to the death of the Bardi couple;
  – keep tables and chairs in the current arrangement;
  – improve lighting with floor and table lamps;
  – after eventual annexes are built, this function will be transferred, freeing up the area for the reconstruction of the original library with glass shelves.
– pantry and kitchen – keep as they are;
– bedrooms – after the eventual construction of annexes to the collection, the bedrooms can be reconstituted in their original arrangement, with the beds;
– service rooms and laundry – an area that can be adapted to new uses, including the possible demolition of non-structural walls between the environments.

Urgency: recommendation

2
Establish expographic criteria to guide art and collection exhibitions in the living room, house and garden (see Addendum 1).

– set periodicity for exhibitions so that the living room remains most of the year in a configuration close to that existing at the time of Pietro Maria Bardi's death in 1999;
– have an exhibition schedule released 12 months in advance, in order to guide visitors;
– submit external exhibitions to the preservation bodies of the historical heritage: Conpresp, Condephaat and Iphan;
– avoid obstructing the vision of the Casa de Vidro with artistic interventions;
– establish criteria for third party exhibitions at the House.

Urgency: recommendation

Action 8

In order to ensure visual and spatial continuity with the surrounding tropical garden, implement a tree management plan.

Associated projects:

Implement the tree management plan in the area surrounding the Main House, eliminating risks to the integrity of the architecture and of the users.
– obtain approval of the Management Plan from the City Hall and the historical heritage preservation bodies (Conpresp, Condephaat and Iphan);
– obtain, from Conpresp, authorization to use the resources of the transfer of the constructive potential;
– develop a communication plan to explain to society the reasons for tree felling and pruning, avoiding negative repercussions;
– hiring landscaper to coordinate and specialized company to perform the cuts and pruning;
– establish order of progressive implementation of the plan;
– carry out a new landscape evaluation of the Casa de Vidro after management.

Urgency: emergency

Goal 2

Preserve the attached buildings (Caretaker's House, Garage and Studio) as testimony of the transformations in the architectural and cultural conception of Lina Bo Bardi.

Description:
Lina Bo Bardi designed each annex according to her architectural conceptions of the moment. For this reason, the three annexes have quite different forms, techniques and uses. The Caretaker's House was built along with the main house. The Garage represents her dialogue with Bruno Zevi and organicism. The Studio was designed according to her research on popular architecture.

Preservation should be guided by the degrees of importance and authenticity proposed in the Declaration of Significance and the Matrix of Significance, adapting them to the needs of use as a house museum.

The guidelines for this goal are:

1
maintain the external integrity of the Garage's architecture, adapting its interior, through furniture and sanitary facilities, to the welcome visitors;

2
maintain the Studio's complete integrity by adapting its interior, through furniture and facilities, to support course, seminar, workshop and conference activities;

3
maintain the volumetric integrity of the Caretaker's House, especially the garden roof, preserving its use until new uses are defined and adaptations are built;

4
include Garage, Studio and Caretaker's House in the Universal Accessibility Plan.

Action 1

Recovery of the garden roofs of the garage and of the Caretaker's House, redo the waterproofing and consolidate vegetation of appropriate size. Preserve the tightness of the studio's garden roof.

Associated projects:

1
Recovery of the tightness of Garage's garden roof (item GA.01.02).
– after tree management, which will exclude trees grown on top of garden roof, remove existing shrub vegetation and preserve for replanting;
– remove the soil and evaluate the conservation status of the waterproofing;
– redo the waterproofing with the same system for all garden roofs (Caretaker's House, Garage, Studio);
– reconstitution of the original landscaping.
Urgency: mid-term

2
Restoration of watertightness of the garden roof (item CC.01.03) and retaining wall (item CC.02.02) of the Caretaker's House.
– after construction of the centralized water tank, remove the provisional PVC water tank from the slab;
– remove the soil and evaluate the conservation status of the waterproofing;
– redo waterproofing with the same system for all garden roofs (Caretaker's House, Garage, Studio);
– reconstitutions of the landscaping;
– remove soil near the retaining wall and make inventory recommendations.
Urgency: mid-term

3
Preserve the tightness of the garden roof of the Studio hydraulic module (item ES.01.05).
– check the appearance of moist points;
– if moist occurs, apply the procedures described for the Garage.
Urgency: recommendation

Action 2

Garage adaptations in order for it to become a Reception hall, preserving its external volume. External additions must be made at a level and distance that do not prevent the view of the back wall from the street.

Associated projects:

1
Replacement of the gate.
· make a project with a lighter structural system with larger capacity that avoids the structural arrow when opened;
– maintain the accordion opening system;
– maintain the external appearance, ie the dimensions and orientation of the exterior wood paneling;
– obtain authorization from historical heritage preservation agencies: Conpresp, Condephaat and Iphan.
Urgency: mid-term

2
Complete the Reception's internal facilities.
– develop lighting design;
– install panels and screens with informational videos.
Urgency: recommendation

3
Complete the Reception's external facilities.
– develop volume project attached to the Garage for toilets, located at the rear, at a level that does not obstruct the view of the volume from the street;
– creation of external space with benches for waiting.
Urgency: short term

Action 3

Adaptation of the Studio as a Multipurpose Room for lectures, debates, workshops (already equipped with screen and projector).

Associated projects:

1
Develop layout for each use situation. study of maximum capacity for use as auditorium;
– plan of folding tables for workshops, with drawing activities;
– Layout option plans for special event rentals.
Urgency: recommendation

2
Improvement of environmental and acoustic comfort conditions.
– grouting the boards covering the cracks in the floor (ES.01.03 Inventory);
– perform frequent cleaning of tiles, with maintenance to avoid dislocations and gutters;
– check for the emergence of leaks in the garden roof of the kitchen;
– installation of microphone sound equipment;
specific lighting design.
Urgency: mid-term

3
Universal Accessibility Plan
– study of accessibility from the street;
– study of accessibility from the Main House;
– partial adaptation of the bathroom with widening of the door and installation of bars.
Urgency: recommendation

Action 4

Maintenance of the Caretaker's House and study for new uses

Due to its implantation characteristic, with a wall in direct contact with the ground, the Caretaker's House requires special maintenance to ensure its habitability.

The use of the house to house a resident caretaker can be changed through other modes of operation. If we choose to keep a resident caretaker, this function could be transferred to a new building or to part of the annex that will house the Institute's collection and research activities in the future. The internal division of the house is not structural, nor does it have significant historical value which would require its preservation. Even openings – windows and doors – can be changed without substantially interfering with the preserved set.

The proximity of the Caretaker's House with Seguidilha Street may give it the function of a Reception in the event of creating a new access to the set.

The following projects should be carried out after Action 1 of Project 2 of this goal – the restoration of the garden roof tightness and of the retaining wall.

Associated projects:

1
Improvement of environmental comfort conditions (besides waterproofing).
– create a project of ventilation system near the inner wall of the retaining wall. The system must allow cross ventilation;
– selection of heating system of the interior of the house.
Urgency: mid-term

2
Removal of additions (besides water tank).
– removal of the front cover of the terrace;
– removal of the lateral service area;
– project of new service support system, inside the house.
Urgency: recommendation

3
New interior distribution according to the proposed uses.
– use as a temporary artistic residence: maintain the distribution of the walls and improve the quality of the environments and furniture;
– use as a Reception for new access through Seguidilha Street;
– improve integration with the side gate and access conditions.
Urgency: recommendation.

4
Universal Accessibility Plan.
– study of accessibility from the street;
– study of accessibility from the Main House;
toilets adaptation project.
Urgency: recommendation

Goal 3

Make the garden enjoyable for visitors, seeing it not just as a complement to architecture.

Description:
The garden was built by the couple, who selected tropical species from Brazilian and exotic flora, personally planting them and taking care of them. Uncontrolled growth must be reversed, and the garden can be maintained with features that allow light to enter, flower, and walks.

In order to achieve this goal it will be needed to:

1
manage the trees so that they remain in dimensions that qualify the garden and do not pose a risk to the physical integrity of buildings and people;
2
undertake landscape design for shrub and forage vegetation;
3
recover the landscaped environments and existing constructions in the garden;
4
design new circulation infrastructure within universal accessibility standards;
5
implement didactic garden visitation paths, with emphasis on the remarkable trees;
6
create service areas for pruning storage, composting and seedling nurseries;
7
create schedule of events in the garden.

Action 1

Manage the trees so that they remain in dimensions that qualify the garden and do not pose a risk to the physical integrity of buildings and people.

Associated projects:

Tree Management Plan.
– elaborate communication plan so that the felling and pruning are understood as a positive action, consistent with the preservation and enrichment of the garden;
– hire a landscaper to assist in the process of approval of the plan at public agencies;
– bid for the execution of the plan;
– develop products from cut trees for selling in the store.
Urgency: emergency

Action 2

Floristic enrichment
of shrub and forage vegetation, benefited by the incidence of sunlight after management.

Associated projects:

Develop specific landscape design and implement it. The project should recover the characteristics of the original garden, identified by research already carried out in this plan.
Urgency: mid-term

Action 3

Recover the landscaped environments, vegetables garden and aromatic garden, and the existing constructions in the garden (walls, paths, stairs, "*vasca*" and living floors).

Associated projects:

1
Recovery of garden walls according to Inventory recommendations (PA.01.02).
– select the walls that need some kind of stabilization;
– in severe cases, build internal wall, leaving the damage in the existing one;
– in cases where there is no risk of collapse, leave it as it is.
Urgency: short term.

2
Recovery of paths.
– Re-fix the stones according to the Inventory recommendation (PA.02.01).
Urgency: short term

3
Construction of new handrails according to the stairs and ramps table.
– design new handrails on critical sections that do not have this equipment, so they are compatible with the preservation of the heritage site.
Urgency: mid-term

4
Elimination of interference from air infrastructure according to Inventory (PA.03.02).
– lowering the pipe to ground level between rocks when crossing the path floor;
– lower the pipes vertically outside the walls.
Urgency: short term

5
Reactivate the vasca 1, frontal (PA.02.08).
– install aerator for reserved water;
– paint it internally;
– redo landscaping project of the water mirror.
Urgency: short term

6
Define use for vasca 2 (PA.02.09), associated with the rear living floor.
Urgency: mid-term

7
Adapt the old courtyard rose garden (between bedrooms and service rooms) to an aromatic garden.
– carry out the management plan and remove trees that have accidentally grown in this garden;
– undertake landscape design for cultivation of half-shadow species such as camellias, shadow lilies, calatheas and marantas;
– insert the garden in the visiting path.
Urgency: short term

8
Recovery of vegetables garden.
– hire technical assistance for the reactivation and maintenance of the vegetables garden;
– cultivate aromatic and culinary plants to support visitation.
Urgency: mid-term

Action 4

Design new traffic infrastructure within universal accessibility standards.

Associated projects:

1
After the implementation of the management plan, perform topographic survey on previously selected sections.
Urgency: short term

2 Design side ramp to the house, connecting the floor of the pilings to the main floor.
– create a project and submit it to the preservation bodies of the historical patrimony and the Permanent Commission of Accessibility of the City Hall;
– ask Conpresp to authorize the use of funds obtained from the transfer of constructive potential;
– bid and monitor the work.
Urgency: emergency

3
Design accessible path near the lower wall, connecting the main gate to the Studio.
– create a project and submit it to the preservation bodies of the historical patrimony and the Permanent Commission of Accessibility of the City Hall;
– ask Conpresp to authorize the use of funds obtained from the transfer of constructive potential;
– bid and monitor the work.
Urgency: mid-term

4
Design accessible pathway linking the Studio to the Caretaker's House.
– create a project and submit it to the preservation bodies of the historical patrimony and the Permanent Commission of Accessibility of the City Hall;
– ask Conpresp to authorize the use of funds obtained from the transfer of constructive potential;
– bid and monitor the work.

Urgency: mid-term

5
Design tower elevator connecting Main House, Studio and Caretaker's House with use of walkways, if necessary.
– create a project and submit it to the preservation bodies of the historical patrimony and the Permanent Commission of Accessibility of the City Hall;
– raise specific resources for the construction of the set.

Urgency: recommendation

Action 5

Implement the didactic garden visitation paths proposed by the landscaping team.

Associated projects:

1
Blue course – low difficulty.
– Short route connecting the ramp level to the Garage, crossing the garden.
– resettlement of floor stones (PA.02.01);
– handrail installation on critical sections (according to stairs and ramps table).

2
Yellow course – medium difficulty.
– resettlement of floor stones (PA.02.01);
– handrail installation on critical sections (according to stairs and ramps table).

3
Purple course – high difficulty.
– resettlement of floor stones (PA.02.01);
– handrail installation on critical sections (according to stairs and ramps table);
– elimination of air infrastructure interference in accordance with the Inventory (PA.03.02).

4
Red course – high difficulty, with obstacles.
– resettlement of floor stones (PA.02.01);
– handrail installation on critical sections (according to stairs and ramps table);
– elimination of air infrastructure interference in accordance with the Inventory (PA.03.02).

5
Highlight the remarkable trees with identification.
– prepare identification project with visual communication;
– prepare QR code project to provide more information on species.

Urgency: short term

Action 6

Create service areas for pruning storage, composting and seedling nursery.

Associated projects:

1
Create areas for pruning storage as outlined in the Landscaping Plan.

2
Create compost area for compost generation, as outlined in the Landscaping Plan.

3
Create seedling nursery for garden management and sale in the reception shop. Recommended location in the northern area of the land.

Urgency: short term

Action 7

Create structured educational programming for the courses, living floors, barbecue area and pizza oven, pilotis and porch of the main ramp.

Urgency: recommendation

Goal 4

Institutional: Deciding whether or not to assume the configuration of a house museum, adapting it to the specific characteristics of the Bardi Institute, a work of relevant architecture, headquarters of a cultural institution with a program of activities and an exceptional collection, consisting of documents and a collection of works of art of the couple Lina and Pietro Bardi.

Description:
The preservation of the Casa de Vidro and the creation of the Bardi Institute were conceived in an integrated way by the Bardi couple. Institutional development is essential for preservation to occur satisfactorily. The Institute is responsible for the fulfillment of the intellectual mission established for it by the Bardi couple upon its founding. This mission includes the preservation of the collection, its use in research, education in the fields of art and architecture and the stimulation of modern Brazilian culture. It is also responsible for obtaining the resources necessary to preserve the estate and remain active.

For this, it is necessary:
1
maintain the integrity of documentary collections;

2
ensure the integrity of the collection of works of art and design, including the manner of presentation in the house itself;

3
increase the publicization of the collections, establishing agreements with related institutions;

4
offer adequate conditions and varied programs for visitation;

5
fulfill the mission of forming public and producers of art history and architecture;

6
build programs to stimulate research in the history of art and architecture, themes defined in the Institute's founding minutes, in partnership with universities, research centers and researchers;

7
plan program, project and construction of specific spaces for the Bardi Institute on the Casa de Vidro plot, as already foreseen by the Condephaat declaration of heritage site;

8
decide whether or not to affiliate the Bardi Institute / Casa de Vidro in the ICOM Demhist;

9
Conduct periodic evaluations of the Institute's cultural policy, with the contribution of intellectuals well-known to Brazilian culture;

10
build a communication policy that reflects the vocation of space and its guidelines, serving different audiences;

11
strengthen institutional relations for strategic partnerships and relationships with governments, organizations and society;

12
create an integrated management policy, with clear guidelines for content / collection, administration, communication and disclosure;

13
structure a project program for annual fundraising, with systematized schedule of actions, including all funding mechanisms and potential sources of funds.

Action 1

Curatorial planning specific to the collection – exhibitions at the house and at other institutions, use of the website for dissemination, publishing, promotion of courses, seminars and conferences.

Associated projects:

1
exhibitions of life records of the Bardi couple, works of art, design and architecture from the collection;
2
development of the website to enhance the dissemination of projects of the Institute;
3
definition of medium term editorial policy;
4
programming of courses, seminars and conferences at the Casa de Vidro or at partner institutions.
Urgency: recommendation

Action 2

Increase collaboration with researchers studying the collection.

Associated projects:

1
selection of priority research projects, through a semiannual public call, which allows the planned use of the collection facilities in a planned manner;

2
incentive to academic partnerships for submission to research funding projects (Fapesp and CNPq) for research support projects that help in the organization of the collection and its dissemination;

3
invite researchers who used the collection to hold lectures and seminars at the Casa de Vidro, presenting the research results;

4
establish rules for the disclosure of the Bardi Institute and Casa de Vidro names in the research that used the collection.
Urgency: recommendation

Action 3

Curatorial policy of the house as a space for exhibitions of contemporary art, architecture and design.

Associated projects:

1
definition of strategic institutional partnerships (eg Masp, IAB, etc.);

2
definition of parameters for project selection;

3
definition of a calendar compatible with the Institute's own programming in the house.
Urgency: recommendation

Action 4

Improvement of the action of the documentary collection through institutional cooperation and conservation equipment update plan. Expand research support capacity.

Associated projects:

1
establishment of cooperation with similar collections networks;

2
review of criteria for access to research, with the creation of programs to stimulate research on topics elected as priorities for the Institute;

3
modernization of the Institute's Information Technology;
– acquisition of new computers and server;
– network update;
– software update.
.
4
review of the layout of the distribution of the collection inside the house, aiming to optimize the use of physical space;

5
review of the service area for researchers.
Urgency: recommendation

Action 5

Build a technical reserve for the existing collection of art and design in the house, which can house it during the emptying of the room to be used as an exhibition space.

Associated projects:

1
review of the use of the lower technical area and its adaptation to house all objects and furniture in the room;
2
provide for technical reserves in future expansion.
Urgency: recommendation.

Action 6

Adapt Reception in the Garage, providing it with toilets, storage space, media for introduction to the history of the house and the Bardi couple, and other facilities; develop and implement Universal Accessibility Infrastructure Plan.

Action 7

Create new specific thematic visitation programs, such as garden walks, plant species identification, bird watching; periodically carry out opinion polls with visitors.

Action 8

Improve the educational service, aligning it with the initiatives of formation and publicization of the collection; develop educational plans in the areas of art history, design and architecture, with regular courses and relevant content for critical training.

Goal 5

Provide the Casa de Vidro with facilities, infrastructure and routines suitable for use as a cultural institution and as a listed historical heritage.

Description:
The Bardi Institute's headquarters use adds to the Casa de Vidro new service infrastructure needs and adaptations to its operating routine. The restructuring of electrical installations in 2012 was a first step, but plumbing and lighting need projects to upgrade. The circulation infrastructure does not comply with universal accessibility standards, and needs to be adapted without compromising the main characteristics of the heritage site. It is also important to introduce new safety management routines from a risk management plan. All these plans and projects must be submitted to the heritage preservation agencies for approval. In the event of incompatibilities between the standards guidelines and the preservation of the heritage site, specific negotiation with the institutions involved should be conducted.

In order to do so, it is necessary to perform:

1
Universal Accessibility Master Plan;

2
Fire Fighting Plan;

3
project of new hydraulic installations from centralized water tank;

4
planning and management of continued maintenance.

Action 1

Universal Accessibility Master Plan that increases the capacity for people with limited motion conditions.

Associated projects:

1
Update the existing planialtimetric survey, highlighting the areas likely to receive ramps.
Urgency: emergency

2
Safety improvement plan for existing stairs.
– evaluate the recommendations presented by the landscapers in the plan and in the stairs and ramps table;
– elaborate a project of installation of new handrails in stairs and external paths;
– elaborate the floor and stairway restoration project, expanding the area when possible and necessary.
Urgency: short term

3
Plan of accessible ramps, elevators and paths in the garden.
– develop a project for ramp 1, next to the Main House, which will link the level of the ramps with the level of the main floor;
– develop accessible road project surrounding the plot, near the wall, along the streets General Almério de Moura and Bandeirante Sampaio Soares, from the Garage to the Studio;
– develop an accessible pathway project from the Studio to the Caretaker's House;
– develop elevator project to connect the Caretaker's House level to Main House level;
– all guidelines should be submitted to the heritage preservation agencies: Conpresp, Condephaat and Iphan.
Urgency: emergency

Action 2

Adapt buildings and gardens to fire safety technical standards without compromising their historic characteristics, protected by heritage.

Associated projects:

1
Project to obtain the Fire Department Inspection Report according to the specifications for Historical Buildings (IT 40/2011).
Urgency: emergency

Action 3

Design of new hydraulic installations from centralized water tank.

Associated projects:

1
Project of the new complete network.
– development of a specialized project for a new hydraulic network and water tank;
– define design parameters that eliminate apparent installations outside the walls of the Casa de Vidro, in particular water tanks and pipelines that invade gutter spaces;
– definition of water tower location directive;
– all guidelines should be submitted to the heritage preservation agencies: Conpresp, Condephaat and Iphan.
Urgency: mid-term

Action 4

Enhance the routine and exceptional maintenance work of the complex, buildings, garden and infrastructure.

Associated projects:

1
Preparation of Maintenance Manual based on inventory recommendations, specifying in detail the interventions and their periodicity.
Urgency: short term

Action 5

Assess the risks of using the property and plan contingency situations.

Associated projects:

1
Preparation of risk management plan.
Urgency: mid-term

Goal 6

Plan new buildings and expand the urban / social insertion of the Casa de Vidro.

Description:
The creation of the Institute was always associated, by the Bardi couple, with the construction of new buildings on the plot of the Casa de Vidro. The process of declaring it a heritage site already provided for the construction of the Institute's facilities. The Institute's expansion guidelines within the plot may be articulated with strategies for the insertion of the Casa de Vidro in the neighborhood, which is endowed with important cultural facilities and another house built by Lina Bo Bardi. The proximity to one of the largest favelas in São Paulo offers the opportunity for partnerships in social responsibility projects.

In order to achieve this goal, it will be needed to:

1
carry out a Master Plan of physical space according to the programmatic needs;
2
structure a network of cultural institutions in the Morumbi region;
3
contribute to the preservation of modern houses and buildings in the Morumbi region;
4
integrate the Casa de Vidro with the neighbors: Morumbi Chapel, Valeria P. Cirell House and Carlos Drummond de Andrade Square.

Action 1

Consolidate a Master Plan for the physical space from this Plan of Management and Conservation.

Associated projects:

· elaborate a program of activities for the expansion, deciding which activities will be developed in the new constructions;
· define usage guidelines for the project;
· obtain resources and hire specialized architectural design staff;
· submit the draft to the approval of the preservation bodies of historical heritage, revising it if necessary;
· executive project development.
Urgency: recommendation

Action 2

Establish joint activities with cultural institutions housed in relevant buildings nearby.
Morumbi Chapel – City Museum, Oscar Americano Foundation, Artistic-Cultural Collection of the Palaces of the Government of the State of São Paulo.
Urgency: recommendation

Action 3

Assist the preservation of Valéria Piacentini Cirell House, designed by Lina Bo Bardi (1958).
Urgency: recommendation

Action 4

Build physical access through Seguidilha Street to Morumbi Chapel, part of the City Museum.
Urgency: recommendation

Action 5

Propose a program for Carlos Drummond de Andrade Square, a green area next to the Institute, preserved by the initiative of the residents of the neighborhood and with the collaboration of the couple Bardi.
Urgency: mid-term

Action 6

Establish social responsibility project with associations of residents of the community of Paraisópolis.
Urgency: recommendation

Action 7

Contribute to the preservation of other modern buildings in the Morumbi region.
Urgency: recommendation

4.4 Summary of projects and phases

Title	Priority	Situation	Financial resources	Referrals				
Tree Management Plan (Goal 3)	Emergency	Ready	Restoration Fund	1 - Make up the Restoration Plan for Conpresp	2 - Submit to City Hall and Condephaat	3 - Approve use of funds in Conpresp	4 - Hire company	5 - communication plan
Roof replacement and maintenance of gutters. (Goal 1)	Emergency	Acquire detailing of the project	Restoration Fund	1 - Make up the Restoration Plan for Conpresp	2 - Submit to Conpresp, Condephaat and Iphan	3 - Donation Agreement with Supplier	4 - Contract of complementary technical services	5 - Implement project
Universal Accessibility Projetc: ramps, elevator, reforces, stairs, toilets (Goal 6)	Emergency	Guidelines defined in PMC. Acquire project for approval	Restoration Fund	1 - Make up the Restoration Plan for Conpresp	2 - Submit to Conpresp, Condephaat and Iphan	3 - Develop executive project	4 - implement project in phases	
Fire Safety Project (Goal 6)	Emergency	Guidelines defined in PMC. Acquire project for approval	Restoration Fund	1 - Make up the Restoration Plan for Conpresp	2 - Submit to Conpresp, Condephaat and Iphan	3 - Submit to the Fire Department, special commission for heritage sites	4 - Implement project	
Frame and Glass Main Room (Goal 1)	Short term	Acquire detailing of the executive	Restoration Fund	1 - Make up the Restoration Plan for Conpresp	2 - Submit to Conpresp, Condephaat and Iphan	3 - Supplier Donation Agreement	4 - Contract of complementary technical services	5 - Implement project
Continued maintenance plan from inventory recommendations (Goals 1, 2, 3, and 6)	Short term	Inventory Ready	Restoration Fund	1 - hire specialized staff	2 - Submit to Conpresp, Condephaat and Iphan			
Hydraulic Design with Centralized External Water Tank (Goal 6)	Mid-term	Guidelines defined in PMC. Acquire project for approval	Restoration Fund	1 - acquire project	2 - Submit to Conpresp, Condephaat and Iphan	3 - implement project in phases		
Risk management project. (Goal 6)	Mid-term	Hire specialized company	Not forecasted					
Landscape Design - Complementary - Floristic enrichment, understory. (Goal 3)	Mid-term	Guidelines defined in PMC. Acquire project for approval	Not forecasted	1 - Get resources for deployment	2 - Hire specialized company	3 - Implement project		
IT project to modernize the Institute's facilities (Goal 4)	Mid-term	Preliminary guidelines defined in PMC	Not forecasted	1 - Get resources for deployment	2 - Hire specialized company	3 - Implement project		
New layout project for the Institute's activities in existing spaces (Goal 4)	Mid-term	Preliminary guide-lines defined in PMC	Not forecasted	1. Acquire specialized project				
Master Plan for Expansion of Physical Space (Goal 5)	Mid-term	Preliminary guide-lines defined in PMC	Not forecasted	1 - Submit to Conpresp, Condephaat and Iphan	2 - Set priorities for project development			
Urban and Municipal Insertion Plan (Goal 5)	Mid-term	Preliminary guidelines defined in PMC	Not forecasted	1 - Set priorities in the internal environment	2 - Establish dialogue with stakeholders			

4.5 Financial Sustainability

Transformation of the garage into a reception space for visitors and store. Photo: IB

Temporary structure for Maria Bethania's show for fundraising. 2018. Photo: IB

The Conservation Fund as a funding strategy for the Conservation Management Plan and other fundraising initiatives.

For the execution of this Plan of Goals, the Instituto Bardi has a new fund, the Conservation Fund for preservation works. A Conservation Fund was created in 2017 with the resources obtained through the sale of Constructive Potential of the land where the Casa de Vidro is located. The transfer is a legal instrument provided for in the City Statute (Law 10,257 of July 10, 2001, which regulates the "Urban Policy" chapter of the Brazilian Constitution). The purpose of the law is to transfer the construction potential of a lot that is affected by restrictions imposed by the Government, in this case, the property being listed by heritage authorities. The Institute was successful in its call for the creation of a Special Cultural Preservation Zone of the city of São Paulo for the Casa Vidro site in 2016 when the new Land Use and Occupation Law draft. This was an essential requirement for the construction potential transfer to be approved.

The sale of this potential began in 2016. The value obtained at this time corresponds to R$ 1,236,145 ($ 327,022)

The funds must be exclusively used for the restoration and maintenance of the property. The Institute understood that the CMP would be the basis on which the restoration and maintenance projects would be prepared. The technical surveys, consisting of diagnostics and identification of pathologies of the state of the building and gardens, support recommendations for maintenance, intervention and restoration that are grouped into plans and projects to be developed, detailed and implemented in the coming years.

The financial sustainability of the preservation of historical heritage in the current Brazilian political framework is restricted to what can be collected by the institution itself directly, without the possibility of relying on public resources or supporting cultural projects of state-owned companies, historically the main source. In this context, with the Conservation Fund the full implementation of the CMP is not guaranteed. The urgent and some short-term actions listed in the Goals Plan and Project List may be able to be accomplished.

During the elaboration of this plan, the interaction between Sol Camacho, Instituto Bardi Cultural Directorate and the University (IAU USP) staff allowed some ideas to become immediate actions. Proposals for exhibition themes, activities with the public and temporary adaptation of some spaces already have had effects for raising resourses aiming at the sustainability of the Glass House and the institution.

Listed here:

Development of new logo and graphic project that associates Instituto Bardi with the Casa de Vidro.

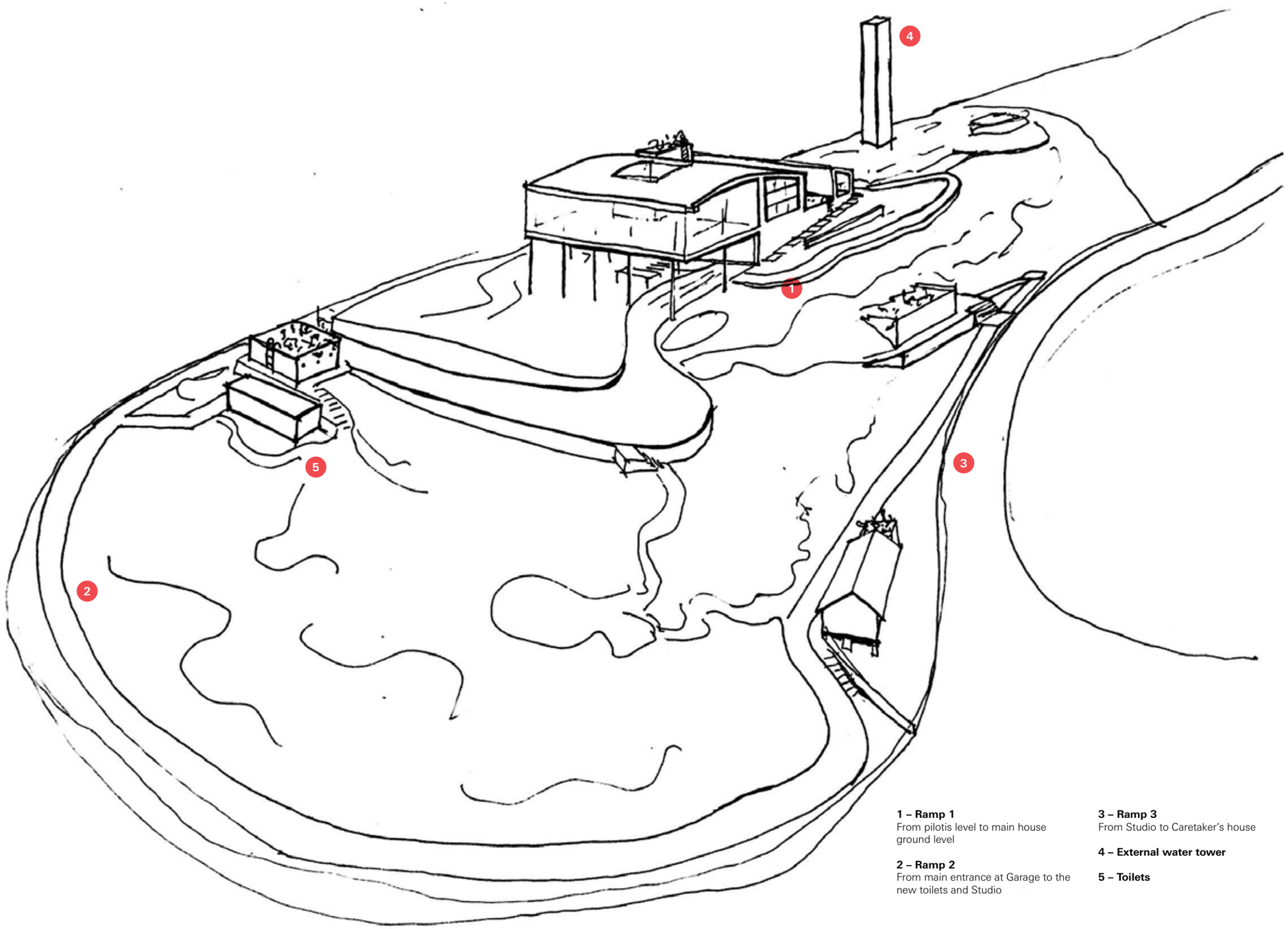
Temporary exhibitions presenting 'The House as a Home', presenting the Bardi residence as they lived it, thematic exhibitions and contemporary art exhibitions, which establish different relationship with the space of the House, deepening an articulation between the work and the space in which it operates. The exhibitions were discussed with intellectuals, artists and architects interested in historical heritage in February 2018 (transcribed in annex 5.1).

Adaptation of the studio to cultural training activities such as lectures, workshops, technical meetings and welcoming visitors. Old models that occupied this space were removed, and allocated 30 Frei Egydio chairs donated by Marcenaria Baraúna (which produces them under license) were allocated. Datashow and retractable screen were installed.

Transformation of the garage into a space for visitors reception and design store. The garage was used as a deposit and technical reserve of the Institute. Through sponsorship, it was emptied and now used to support visitors, with information about the history of the house and its founders, and sale of books and souvenirs. The interventions were made without fixed changes, using only furniture and lighting. The plan also proposes the construction of toilets and accessible route for wheelchair users in the medium and long term stages.

Improvement of the donation model and organization of fundraising events for the Institute. Considering the need to preserve the objects of art and furniture in the living room, it is not recommended for audiences larger than 60 people simultaneously within the main house, even though the structural calculation has estimated that the structure can hold up to 500 people (according to report Annex 5.2). For fundraising events that attract a larger number of guests, the Bardi Institute's cultural director, architect Sol Camacho, designed a temporary structure to be built with Cross-laminated timber CLT to form a partially covered platform for up to 200 people. Located over the circular parking access to the house, the platform advances over the garden avoiding the tree trunks and studio access ladder. The structure was set up in December and January, usually with less visitation, allowing a program of activities such as shows, lectures and parties, aimed at raising funds for the maintenance of the Institute.

4.6 Master Plan for Expansion and Urban Integration



Master Plan

The interventions proposed by the Goals Plan for the area outside the Casa de Vidro require the organization of a Master Plan for the expansion of physical space (Goal 5) that goes beyond the specifics of a landscape project.

The guidelines for the Master Plan are:

1
Stairs and Ramps to give universal accessibility conditions to all buildings (Goal 6). Proposed location of new toilets and water tank (Goal 6).

2
Plan of Urban Insertion into the immediate neighborhood: Carlos Drummond de Andrade Square, Valeria P. Cirell House and Morumbi Chapel (Goal 5).

3
Situation map of the Casa de Vidro in São Paulo. Reference to the limits of the urban area when it was built and nowadays (Goal 5).

1 – Ramp 1
From pilotis level to main house ground level

2 – Ramp 2
From main entrance at Garage to the new toilets and Studio

3 – Ramp 3
From Studio to Caretaker's house

4 – External water tower

5 – Toilets

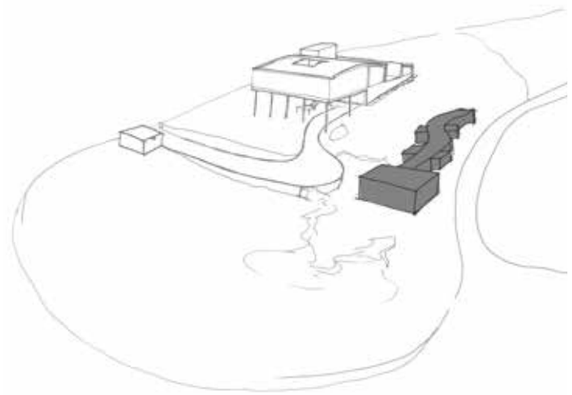


Figure 1.
Pietro Maria Bardi's sketch simulation for the Institute's venue at the Casa de Vidro site, 1976

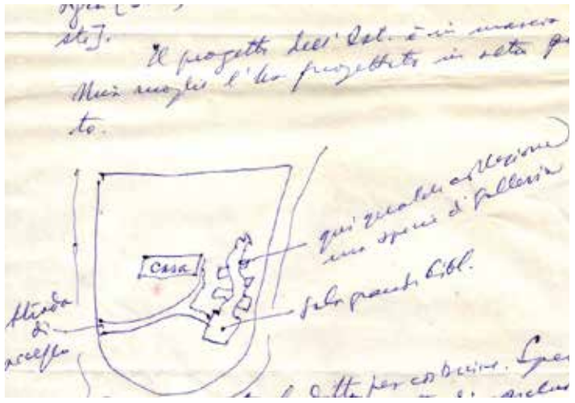


Figure 2
Pietro Maria Bardi sketch for the Institute's venue at the Casa de Vidro, 1976. Source: Pietro Maria Bardi letter to Ettore Camesasca, 02/01/1976. Fonte: Archivio Ettore Camesasca, Milano.

Guidelines for New Construction on Casa de Vidro plot

The Bardi project for the constitution of the Institute is contemporary to the construction of their house itself. As Sanches noted (for a full analysis, see **item 5.1** of the report), there are in several documents references to the Contemporary Art Institute (IAC), linked to the Masp, close to the Casa de Vidro plot. Among the sets of plots listed, one corresponds to the plots of the Casa de Vidro, while the other to the "Land reserved for the 'Art Institute of São Paulo'". The idea of the House as a cultural space is in its own constitution.

In the 1970s, in a letter to Etore Camisasca of 1976, Pietro takes up the subject, presenting to his friend in Italy sketches of a possible implementation on the plot of the Casa de Vidro. Figures 1 and 2.

This sketch resembles study drawings for the expansion under and beside the house, without identification or date in the collection, published by Oliveira as being "studies for the expansion of the Casa de Vidro, carried out in the 1970s, where Lina proposes a pavilion at the foot of her residence". Figures 3 and 4.

In the declaration of the Casa de Vidro as a heritage site, as already mentioned, the couple begins to realize the intention, cultivated for decades, of transforming the Casa de Vidro into the headquarters of an institute.

Lina and Pietro's sketches for the Institute's headquarters project on the Casa de Vidro plot show great freedom in the formal design and occupation of the tree-filled area. However, in the following years, the only construction carried out was the Studio, a formally contained project, where the structure and the wooden walls are covered by a discreet gable ceramic roof.

To date, the only annex building project to house the Bardi Institute was undertaken by architects Roberto Loeb and Luis Capote in 2015. Its design was based on respect for the existing vegetation, looking for clearings between the trees to build small high volumes of the ground and interconnected by elevated walkways. Figures 5 and 6.

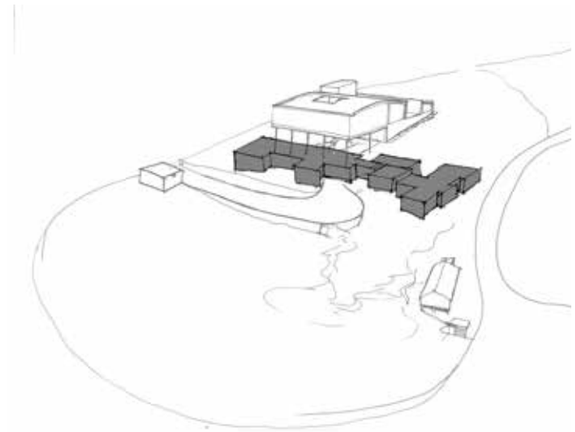


Figure 3
Simulation of Lina Bo Bardi's sketch for the Institute at Casa de VIdro

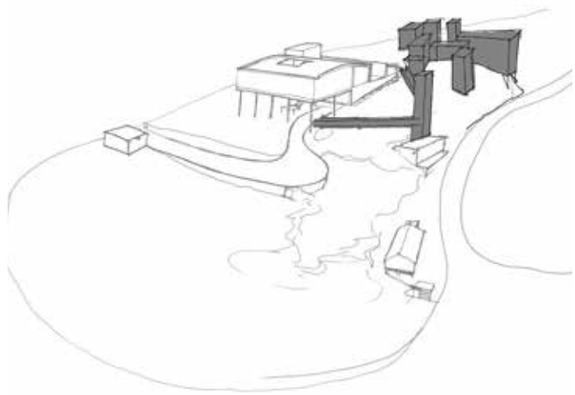


Figure 4
Project view of Lina Bo Bardi for the Institute's venue at the Casa de Vidro,. Source Instituto Bardi.

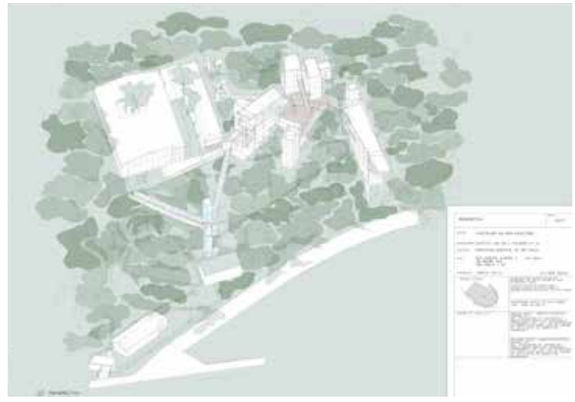
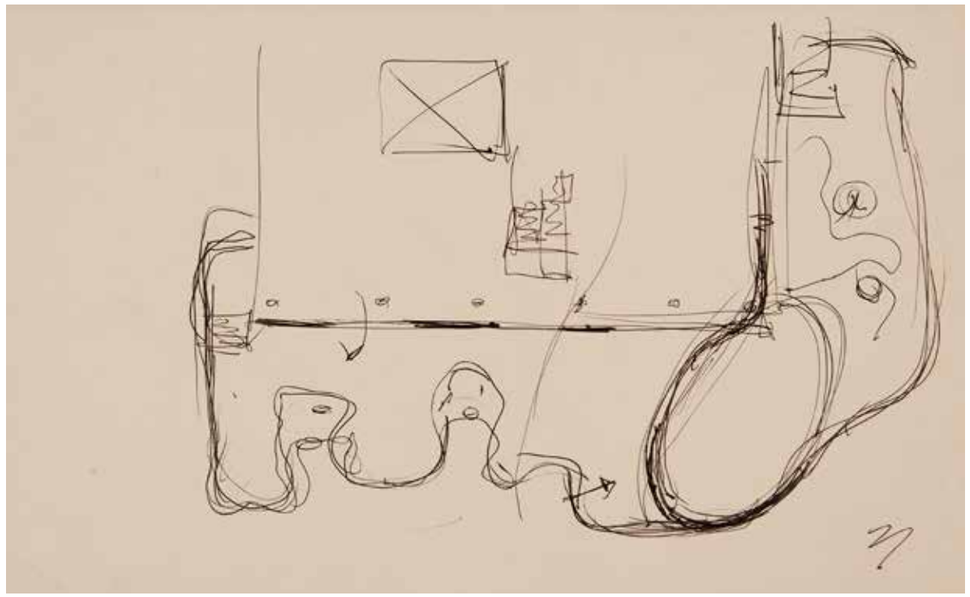
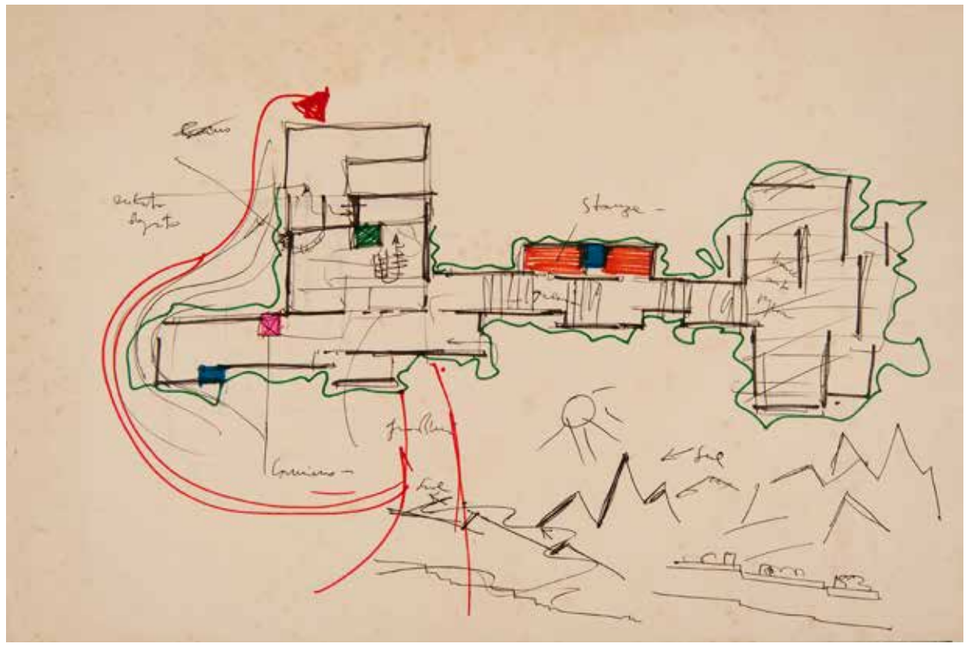


Figure 5
Simulation preliminary project for the expansion Institute at the Casa de Vidro, Roberto Loeb and Luis Capote architects, 2015.

Figure 6
View of the preliminary project for the expansion Institute at the Casa de Vidro, Roberto Loeb and Luis Capote architects, 2015.

Figures 7 and 8
Lina Bo Bardi sketches for the Institute's headquarters in the Casa de Vidro pilotis area. Source: Instituto Bardi





The set was submitted to a BNDES culture support notice, receiving a pre-approval, pending the approval of the intervention by the municipal (Conpresp), state (Condephaat) and federal (Iphan) historical heritage defense agencies.

In July 2016, architect Marcos Carrilho, coordinator of the Technical Division of the Iphan Superintendency in São Paulo, issued a technical opinion in which he requested the "review of the projects", aiming at reducing the interference in the area. In his analysis, Carrilho considers that the assumption of the proposal was the fragmentation of volume to preserve the existing vegetation. However, it points out that its dispersion occupies an area that exceeds the dimensions of the main building, which leads to evaluate that the declaration of it as a heritage site defines as order of importance "three main elements, the residential building, the surrounding garden and, finally, the artistic collection".

As the garden is an almost spontaneous formation, Carrilho understands that its regeneration over time can absorb the new buildings, as long as they do not intend to compete with the main building for protagonism. Since the architect did not change the proposal in this direction, the proposal was not approved in a new analysis carried out in November of that same year, awaiting eventual revision.

Carrilho's analysis provides guidance for the definition of areas that can be occupied by new buildings, making clear the importance of preserving the primacy of the house in relation to vegetation.

Studying the open areas, the locations and slopes, the relationship of existing buildings with them, the new universal accessibility infrastructure and the vegetation, two areas were defined that could receive buildings to house the Institute's uses, based on subtlety and discretion, because the protagonist is the Glass House. Following the orientation of the architect Marcos Carrilho's document, we sought the least impact in relation to the main building and accommodation in the topography.

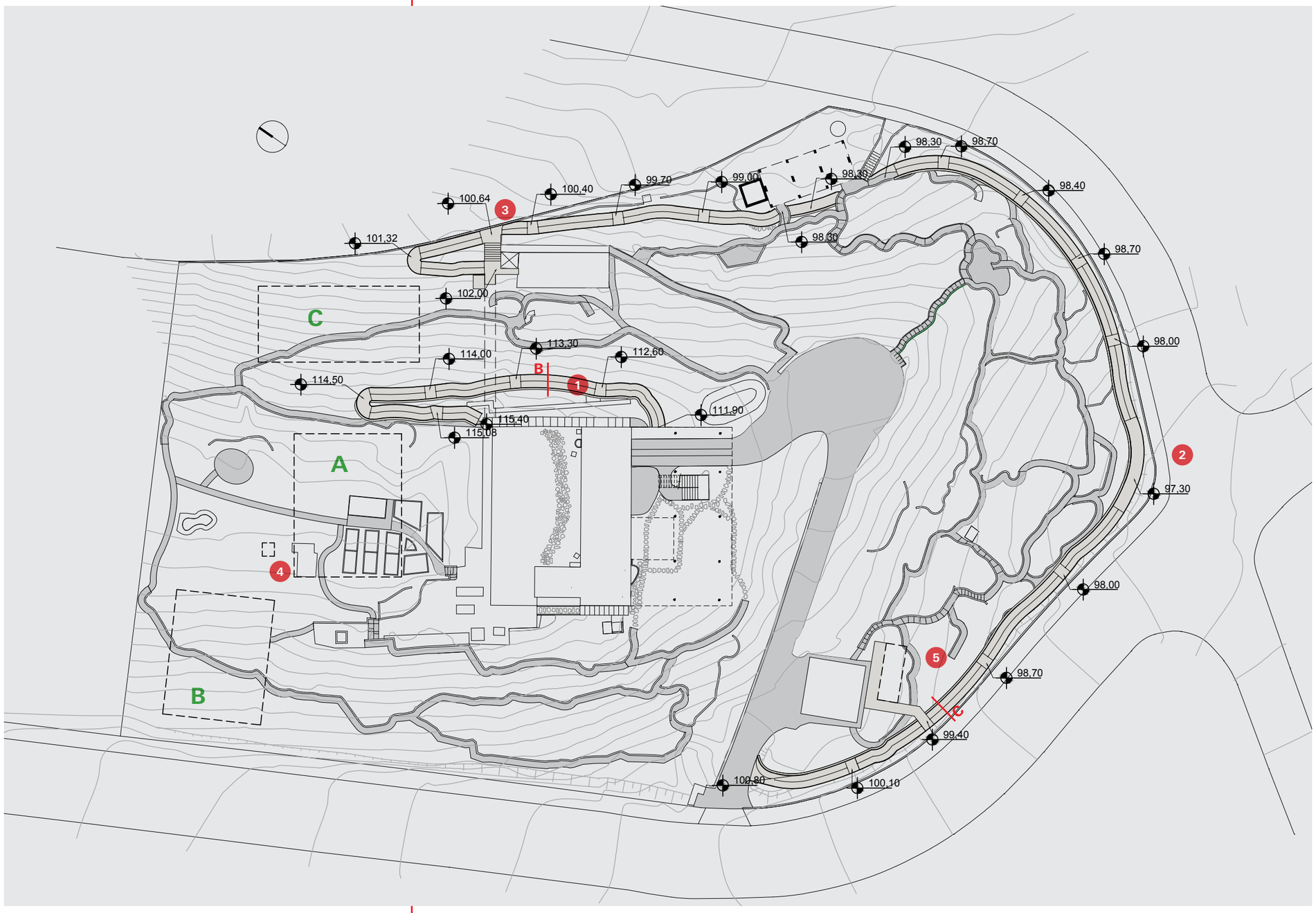
Area for expansion
Option A
Rear area to the main house, with clearing opened by the trees management plan. Ease for direct access to the back of the house. Must respect a minimum distance of 11 meters and not exceed the height of the main house, 5 meters above the main floor. The volume can have lower floors, digging the ground, allowing direct access, lighting and ventilation from the sides. Small visual impact to the complex.

Option B
Back and side area to the main house, located between Rua General Almério de Moura and the ridge of the land. It can allow independent access, direct from the street, offering lift system for people with reduced mobility and for cargo. Medium visual impact to the complex.

Option C
Back and side area to the main house, located between Seguidilha Street and the ridge of the land. To be considered in case of activation of this street according to the guidelines of the Plan of Urban Insertion. It can also allow independent, direct access from the street, providing lift system for people with reduced mobility and cargo, serving the main house, caretaker's house and studio. Small visual impact to the complex.

External toilets
Given the need to offer toilets to visitors, the best option is its construction next to the Reception, installed in the garage. The smallness of internal space requires that they be built externally, like a new volume. Its implementation should be defined in such a way as to interfere as little as possible with the garage's volume. For this reason, the guideline is to deploy them near the rear of the garage, away from the lowered wall approximately 1.70 m below the internal level. Access may be through the first stretch of the perimeter ramp to the ground.

Centralized water tank
The centralized water tank shall be designed as a reinforced concrete tower constructed of sliding or climbing forms. The sizing will be predicted by the hydraulic project, specifying reserve for firefighting in all terrain. The most appropriate position is at the back, at least 24 m from the main house, between the current garden and the "*vasca*" 2.



1 – Ramp 1
From pilotis level to main house ground level

2 – Ramp 2
From main entrance at Garage to the new toilets and Studio

3 – Ramp 3
From Studio to Caretaker's house

4 – External water tower

5 – Toilets

A, B and C
Options for expansion

Ramps and elevator for universal accessibility

The external universal accessibility system is divided into three ramps and one elevator.

The ramps will occupy open spaces by the arboreal management next to the house and the border wall with the street.

Ramp 1

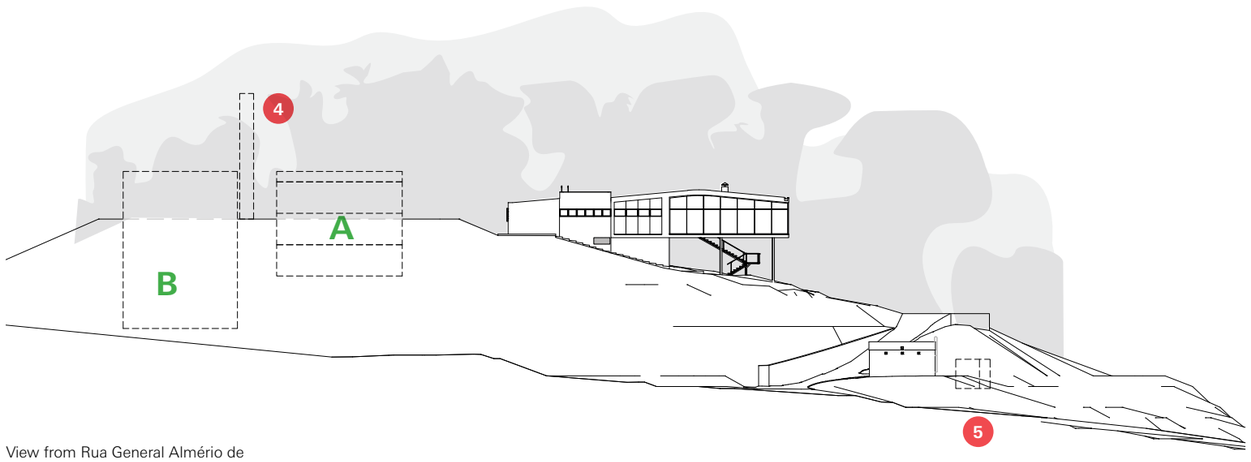
Between the floor of the pilotis and the main floor of the house. The accessibility must be made with vehicle until the ramp between the pilotis, where the first level of the ramp will start. The maximum slope of 8% must be respected, with levels every 10 m of extension. The ramp will run parallel to the side of the house for approximately 42 m towards the back, returning for another 22 m until reaching the rear sidewalk. The floor of this sidewalk should be corrected to a level that allows direct access to the interior of the house through the doors of the service area and kitchen (CV.03.05.01).

Ramp 2

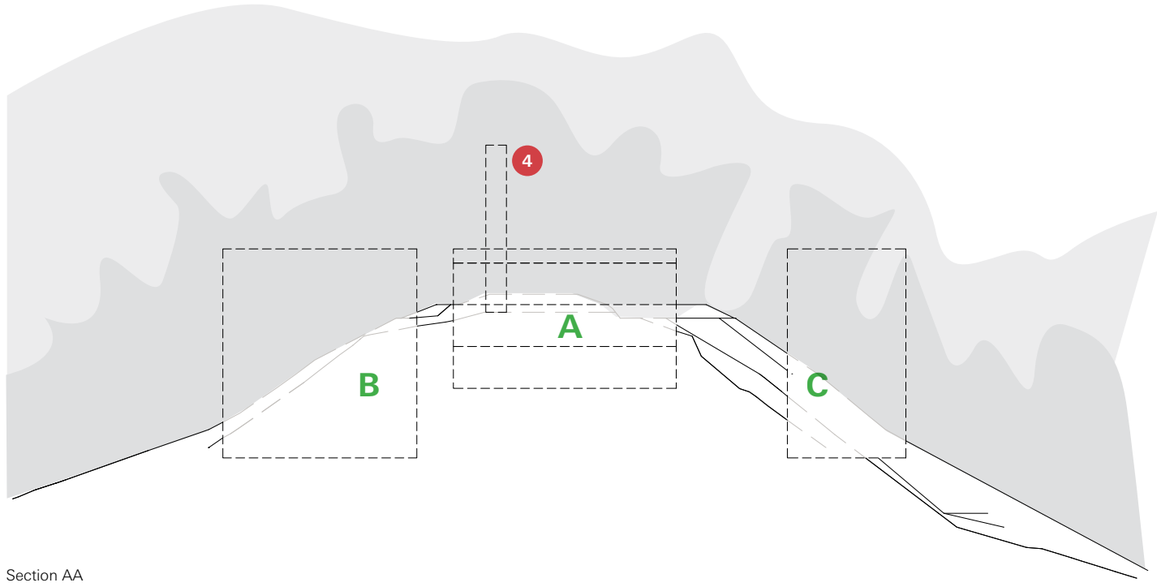
From the main entrance, next to the Garage, to the Studio, serves the external toilets. This ramp will follow along the property's boundary wall with the public road, taking up open spaces with tree management. The 4 m of unevenness will be overcome by a gentle slope path of no more than 8%, which will follow the boundaries of the plot. The floor will be supported by a retaining wall, regardless of the boundary wall.

Ramp 3

From the Studio to the Caretaker's House, the gate to Seguidilha Street and the elevator are served. In the first stretch, between the Studio and the gate, 2.5 m will be done, with 8% inclination and interruptions every 10 m to levels. The second section of the ramp, with two flights of 10 m and 8% inclination, will reach the level of the Caretaker's House, requiring the demolition of the roof used as a service area. At this level is the first stop of the elevator.



View from Rua General Almério de Moura



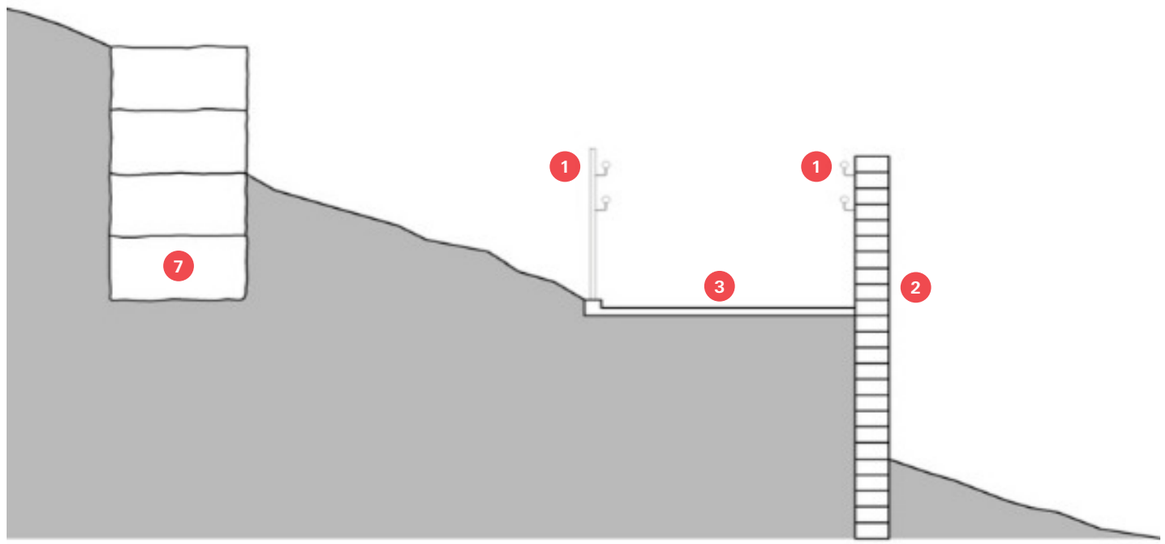
Section AA

Schematic sections indicating recommended position for expansion volumes - water tank, toilets and Institute extension ((options)

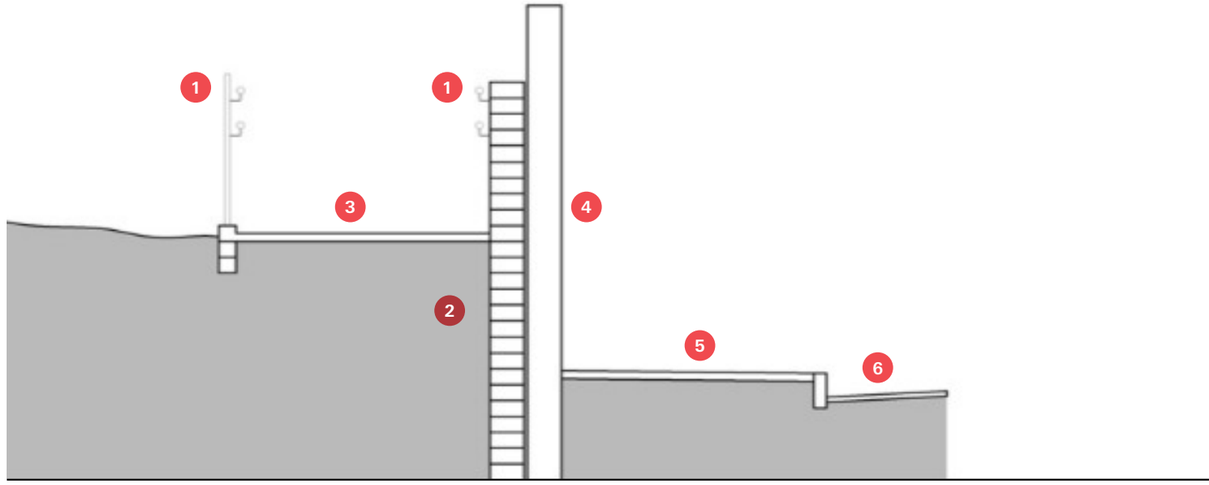
4 External water tower

5 Toilets

A, B and C
Options for expansion



Section B
ramp 1



Section C
ramp 2

1 Handle

2 Retaining wall and sill in concrete block

3 Reinforced concrete flooring with podotactile signaling

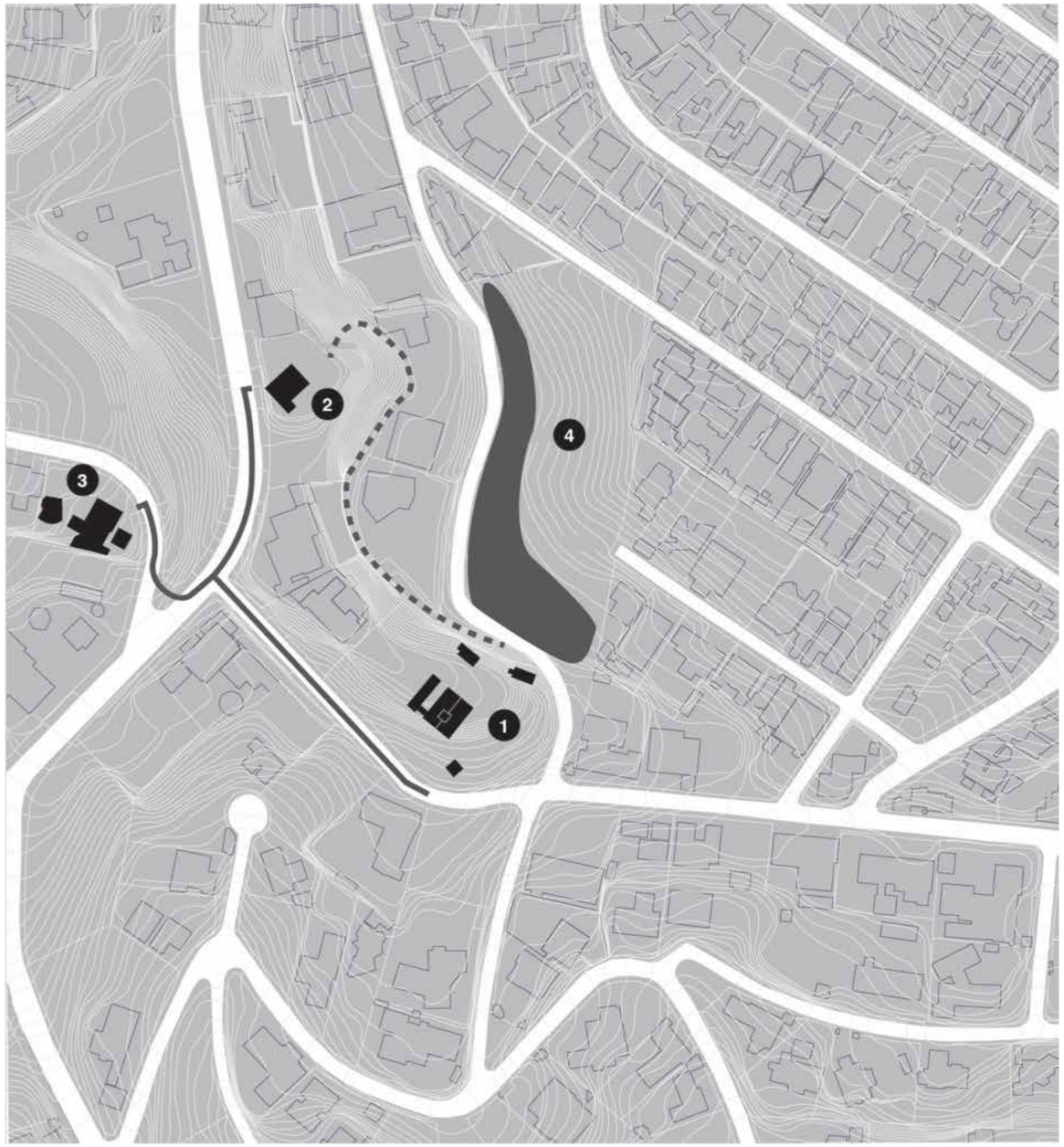
4 Border wall

5 Sidewalk

6 Street

7 Retaining walls of granite “opus incertus” by the side of main house.

Master Plan
Guidelines for urban integration in the immediate neighborhood



Connection Casa de Vidro and Morumbi Chapel through Seguidilha Street

Connection Casa de Vidro, Morumbi Chapel and Valeria P. Cirell House through Gal Almério de Moura Street, Morumbi Avenue and Brigadeiro Armando Trompowsky Street

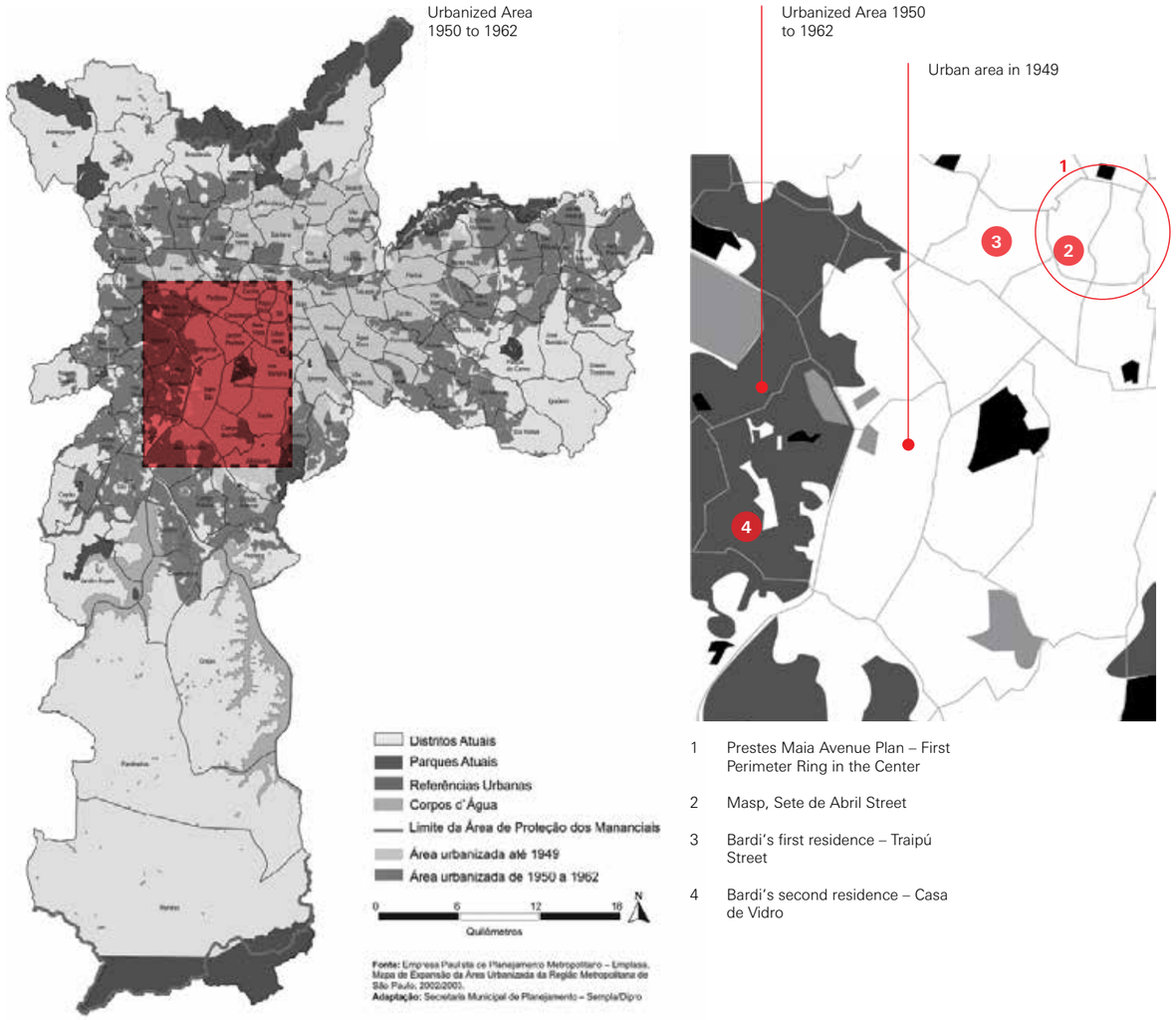
1 Casa de Vidro
2 Morumbi Chapel
3 Valeria Piacentini Cirell House
4 Carlos Drummond de Andrade Square

Morumbi Chapel – Fine arts exhibition hall. Owned to City Museum Municipal Secretary of Culture. Brick masonry complementation of ancient pestle mud ruins. Project by Gregori Warchavchik, 1949. Photo: Renato Anelli

Internal and external view

Carlos Drummond de Andrade Squarel – view from Rua Bandeirante Sampaio Soares, with the Casa de Vidro's border walls at the back. Photo: Renato Anelli.

Master Plan
Situation of the Casa de Vidro in São Paulo Municipal area.



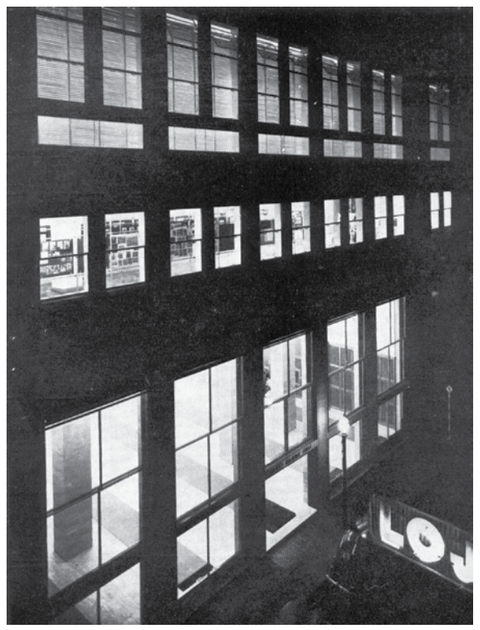
1 Prestes Maia Avenue Plan – First Perimeter Ring in the Center

2 Masp, Sete de Abril Street

3 Bardi's first residence – Traipú Street

4 Bardi's second residence – Casa de Vidro

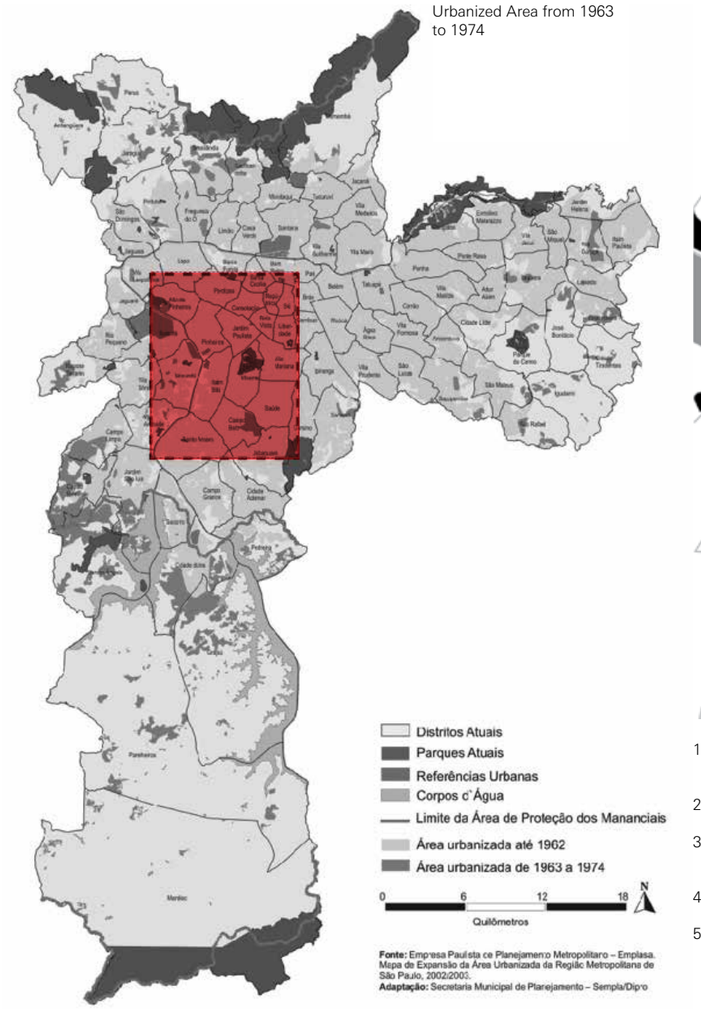
The Casa de Vidro was built in the area that was urbanized between 1950 and 1962. Therefore, in the first ten years since its construction, it moves from a rural situation to a refined suburb neighborhood.

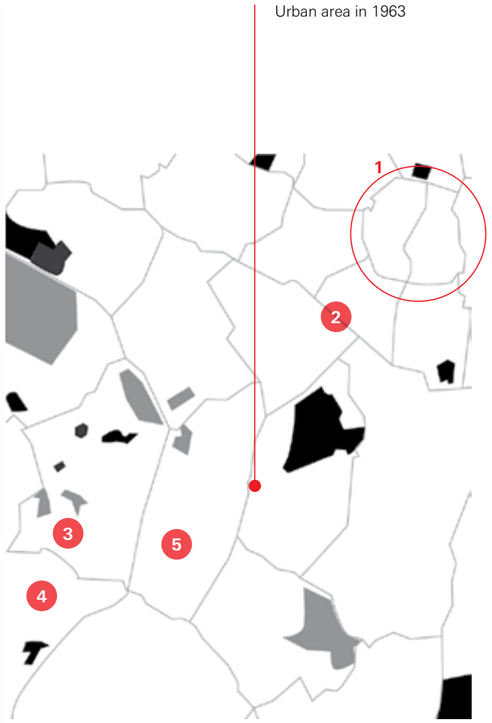


Exterior view of the newly built Glass House in the newly deployed Morumbi neighborhood. Photo: PMB. Source: IB.

Associated Diaries Building at Sete de Abril Street
1951 - São Paulo Art Museum on the first floors
Source: Bardii Institute
2018 - Current view with bank branch at ground floor
Photo: Renato Anelli

Master Plan
Situation of the Casa de Vidro in São Paulo Municipal area.





1 Prestes Maia Avenue Plan – First Perimeter Ring in the Center

2 Masp on Avenida Paulista

3 Bardi's second residence – Casa de Vidro

4 Paraisópolis Favela

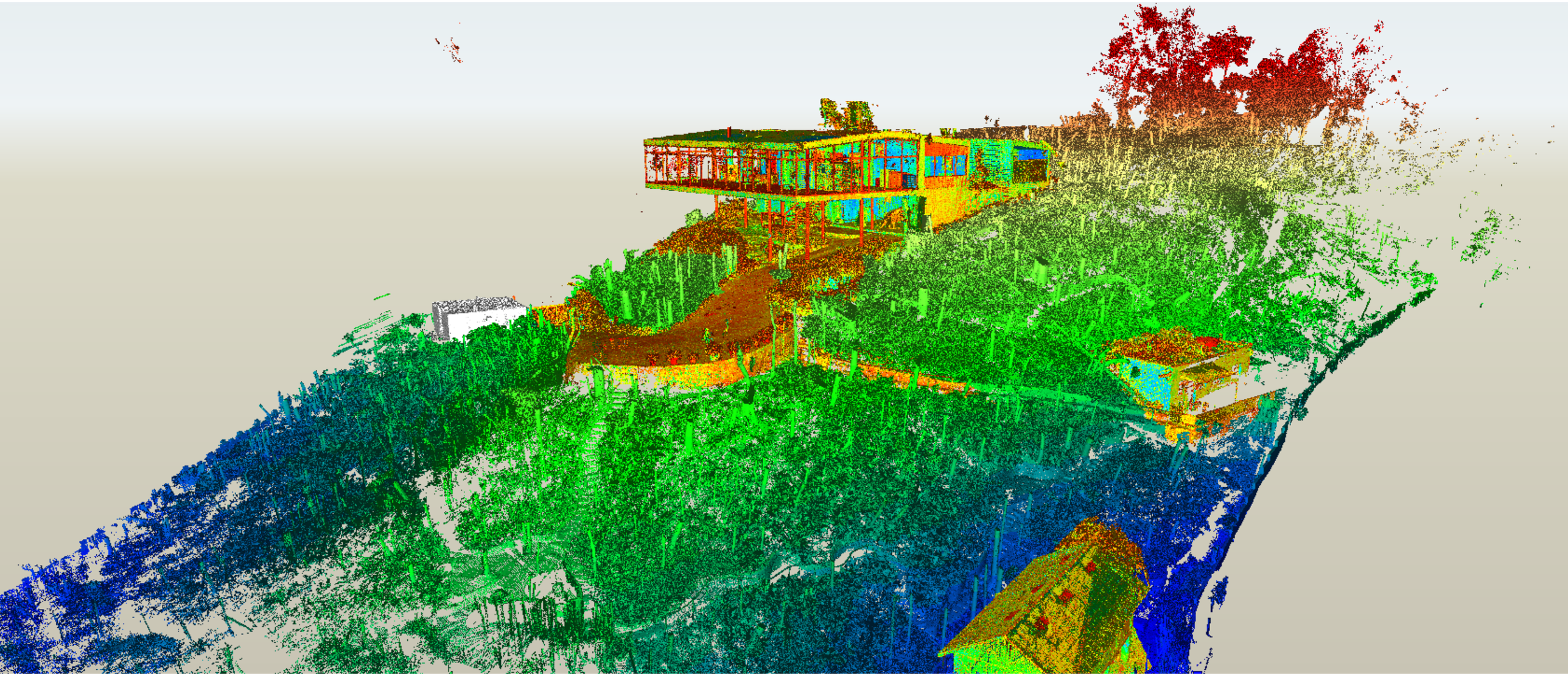
5 New Financial Center of São Paulo – Berrini Avenue, 1990

The occupation of one of the Morumbi Farm installments by low-income migrants occurred simultaneously with the construction of the Casa de Vidro, creating the Paraisópolis favela.
The proximity between both is 1.4 km.

São Paulo Art Museum view from downtown. Photo: Renato Anelli

Paraisópolis: São Paulo's second largest favela, with approximately 43,000 inhabitants. Giovanni Gronchi Avenue buildings on the horizon. Photo: Renato Anelli

5 Production process of the plan



5.1 Stakeholders for the preservation of the Glass House

The preservation of the Glass House is a mission of the Bardi Institute, a cultural institution founded by the couple Lina and Pietro M. Bardi in 1990. For this reason, the Bardi Institute was the proposer of the Glass House project for the Keeping It Modern program of The Getty Foundation in 2015, in partnership with the Institute of Architecture and Urbanism of the University of São Paulo (IAU-USP). Through this agreement it was created the team of specialists who developed this Management and Conservation Plan.

Therefore, the Bardi Institute is the main stakeholder in this process, and its Administrative Council is its decision-making body.

The Bardi Institute, through its technical and cultural director Sol Camacho, and its Administrative Council, worked together with the IAU-USP team in the elaboration of the main researches and debating the reports in workshops every six months.

The expansion of this field of interlocution was established with other categories of social agents, aiming at enriching the process of setting up the plan. They are:

1
Experts, non-governmental organizations, and institutions for the preservation of historical heritage; Docomomo Brasil, Conpresp, Condephaat, Iphan;
2
teams from the other projects supported by KIM program in Brazil - FAU-USP, Masp and Oswaldo Cruz Foundation;
3
researchers and professors of art history and architecture;
4
representative institutions of architects – Institute of Architects of Brazil (IAB) - São Paulo Department;
5
those in charge of the management of other historic houses similar to the Glass House;
6
representatives from the departments of culture, historical heritage and urban planning of the São Paulo City Hall;
7
partner companies of the Bardi Institute that support cultural projects (ABIVIDRO, AGC, etc.);
8
scientific meetings of specialists in the area of preservation of modern architecture, research in architecture, museums, etc.

The contribution of these social agents was developed in special meetings, workshops, reunions and public events, where the research in progress and the guidelines under development could be discussed and improved.

We present below the main occasions of dialogue, classified according to the nature of the institutions and their objectives.

1
Presentation of the project and of the progress of the research, with discussion in the format of a science event. The main institution is Docomomo, an international association dedicated to the documentation and conservation of buildings and sites of modern architecture. The Docomomo is well structured, has been operating since 1993 and has several regional centers. The production of the Management and Conservation Plan (MCP) was carefully monitored by the institution.

May 10 to 13, 2017 - First ICOMOS Scientific Symposium Brazil, Belo Horizonte, MG.

October 16-17, 2017 - Docomomo. São Paulo - Universidade Presbiteriana Mackenzie, São Paulo, SP.

21 to 24 November 2017 - Docomomo. Brazil - Federal University of Uberlândia, MG.

March 21 to 24, 2018 - Docomomo. International Meeting on Modern Heritage and Best Practices: Sustainability, Conservation, Management, and Architectural Design. Santiago, Chile.

October 13 to 19, 2018 - National Meeting of the National Association of Research and Post-Graduation in Architecture and Urbanism - Federal University of Bahia, Salvador, BA.

December 7, 2018 - ICOMOS International Scientific Symposium. Sustainability: Cultural Heritage and Sustainable Development, La Plata, Argentina.

2
Work meetings with specialists at the University of São Paulo, at the City Hall of São Paulo and at Casa de Vidro.

April 24, 2017 - Seminar at the Glass House with Marcello Balzani and DIAPReM team (University of Ferrara). It was presented the point cloud of the Glass House, produced from the survey conducted in January. The teams responsible for the KIM projects of FAU-USP and MASP participated. The seminar and the training workshop of the IAU-USP's team were held in São Carlos, SP, from April 25 to 28.

August 15, 2017 – Heritage Days, Department of Historical Heritage (DPH) of the São Paulo City Hall. Technicians from DPH and those interested in preservation and restoration participated. The presentation of the project and the report of its progress provide a reference example of new methods for preservation in Brazil.

August 28, 2017 - Meeting of KIM Projects of The Getty Foundation in Brazil - Getty Day. FAU-USP, São Paulo. With participation of Mônica Junqueira, Fernanda Fernandes, Flávia Brito, Cláudia Carvalho (Casa Rui Barbosa), Beatriz Kühl, Miriam Elwing (MASP), Silvio Oksman (FAU-USP and MASP). The presentations of the four projects, at different stages of development, allowed the teams to share in a detailed way the discussion about the methodology for elaborating the Management and Conservation Plans inherent to the KIM program. The difficulties of adapting this method to the Brazilian reality were discussed, as well as its advantages to a moment in which the public institutions of support to the preservation lose their capacity of intervention. The MCP emerges as a process that clearly involves the institutions of society in the challenge of preservation, aiming at its economic sustainability.

October 9 and 11, 2017 - Meeting of Glass Houses at FAU-USP, São Paulo. The curators of the houses of Philip Johnson (Hillary Lewis, Scott Drevinig), Farnsworth (Maurice Parrish), Eames (Lucia Atwood) and Bardi (Sol Camacho) participated; the researchers of the KIM project teams from FAU-USP and from the Glass House. The meeting aimed to share experiences in the management of the houses, which have some points in common. There is a huge difference between the preservation methods in the USA and in Brazil, from the institutional framework to the conditions of economic sustainability. The examples of the two houses under the custody of the National Trust for Historic Preservation were quite useful for the development of the MCP of the Glass House. Preservation through the promotion of resource-raising activities is the means of survival to be sought by the Bardi Institute, in the face of the absence of public programs that support conservation. The example of the Eames house is more complex, as it involves the foundation and the Eames office, which work cooperatively, within their specifics. The sharing of experiences of technical conservation of the buildings was also very fulfilling, allowing to understand that leaks in waterproofing, rupture of planes of glasses, oxidation of profiles are common in the architecture built in the postwar period.

On October 11, a public panel was held in the auditorium of MASP, with the same participants, attracting an audience of 200 people. The debate was focused on the public promotion of the houses and of the preservation works in progress.

May 15 to 18, 2018 - The invitation from the international institution Iconic Houses to present the work in progress in the Glass House allowed the participation of the coordinator of the KIM project in other activities of this meeting held in New Canaan. The main one was the Expert Meetings, held on May 15, divided into two parts.

The first was the Alternatives to the House Museum Model, which presented experiences from the US, Denmark and Japan of institutional arrangements for preservation.

The second one was "The American Art of Fundraising", presenting methods of economic sustainability from donations, successfully employed in American institutions.

Both sections provided important subsidies for the development of new economic sustainability procedures for the Glass House MCP, some of them already implemented by the current board of the Bardi Institute.

"Glass Houses" – Lina, Mies, Eames and Philip Johnson". MASP. 10/11/2017.
Panel discussion in the MASP's large auditorium with the curators and directors of the exhibited houses – Hillary Lewis and Scott Drevnig, Johnson Glass House, Lucia Atwood, Eames House, Maurice Parrish. Farnsworth House, Sol Camacho, Bardi's House - Casa de Vidro

Fernando Tulio, at the middle, Ruth Verde Zein and Sol Camacho

Sonia Guarita do Amaral and José Lira

A space that "requires tweezers to cope with": conflicts between exhibition and preservation

The main public debate on the use of the Bardi Institute building was promoted during the exhibition *Casas de Vidro*, held on February 25, 2018, in its studio, and transmitted on Facebook.[1] Intellectuals, professors, architects and researchers gather together to discuss the role of the Glass House and the Institute's as a producer of cultural activities related to the field of architecture, including among such activities the exhibitions themselves. It was requested from the participants an evaluation on the conflict between the preservation of the room according to its original layout – as a historical token of the life of the Bardi couple – and its use for the installation of temporary exhibitions.

The main points expressed by the debaters were:

– The Glass House must be classified as a historical house museum because of its collection, its architecture and for being associated to relevant historical figures.
– The experience of the Bardi Institute in preserving the Glass House may serve as a reference for other similar spaces, especially in São Paulo.
– The exhibitions held in the Glass House must be heedful of the architecture of the house itself. Two statements highlight this need, declaring that the exhibits must negotiate with space and that it "requires tweezers to cope with".
– It is necessary to develop strategies in order to avoid the trivialization of Lina Bo Bardi's figure.

We present below the transcriptions of the main excerpts from the debaters' statements. With some exceptions, the coordinators' statements have been edited to be shortened, as they broadly reproduce the main ideas present in this plan.

Alvaro Puntoni:[2]
The Institute's and the Glass House's importance is consensual. The spaces dedicated to architecture exhibitions are very rare. This debate [on the conservation of such spaces] is very common, several colleagues question the fact that the Lina and Pietro's living room, with its original layout, is not seen here. I would call this a kind of fetishization of a space. But the space is modified, now it holds an exhibition, which is beautiful. If we consider other places, such as the NAI Rotterdam, the Cité de l'Architecture in Paris, with that huge space in the Trocadéro, the MoMA itself, with its historical efforts to divulge architecture, especially the modern one, the CCA, the Casas da Arquitetura in Matosinhos, Portugal. In Lisbon there are private galleries of architecture, such as the Note. It is fundamental that, in a city like São Paulo, there be such spaces. Even the Escola da Cidade has been discussing the possibility of starting an architecture gallery on its ground floor. I think it's amazing that the Glass House is open for activities like this. This debate is great because it would be a mistake to freeze the house in time. If this happens, the house would be doomed to a gradual demise.

Ana Lúcia Cerávolo:
Discussions in the museology field have advanced a lot in recent decades. It is relatively consensual that, if house museums have a unique shape, they will bring in the public only once, people won't return. The house museum needs a cultural project. In the Glass House, the cultural project was developed even before the Institute. The Bardi couple had an idea of encouraging culture, the Institute was born with this mission. We can present the house as it was, but we need to promote more dynamic activities that bring new audiences. Activities that speak of architecture to an audience that would not come here again just to see the house.

Sol Camacho:
The discussion with the other glass houses in 2017 was interesting. With the other houses, the landscape changes a lot according to the season – everything goes white when winter comes; in summer, green – but this house's landscape does not change.

Ana Lúcia Cerávolo:
This happens today, because the idea of PGC is to once more bring in the flowering with the opening of clearings in the tree canopies and start a new landscape design at ground level.

Renato Anelli:
It is impossible to restore the living room as it was, because when Pietro Maria Bardi passed away, the heirs of the first marriage claimed the inheritance and took away lots of furniture and works of art. The pieces you see in the old photos are no longer with us.

Anna Carboncini:
They were sold. Part of it remained in São Paulo, with collectors, but some things were sold abroad. There were precious things, a table from 1600, for example, sold at an international auction.

Renato Anelli:
This table occupied the center of the room in all the pictures of that period. It will not come back.

Marta Bogea:[3]
How is the collection registered, considering the books, the library, the furniture that still remains, the works of art? What kind of safeguard is used? Are they here or in some museum?

Anna Carboncini:
It is all here, it is quite safe, in the sense of being cataloged. All of Lina's drawings have been cataloged and photographed, the photos are online and the originals in the map racks. They are shown only to specialist people, for the sake of safety. Every year we check them to see if they are in order.

Sonia Amaral:
The issue of having a precious collection and gaps of other pieces is not what will define what you have described. Whether we continue being a historical house, with all this fetish of trying to reconstitute this environment of the couple who lived here, or we decide to be simply an exhibition space for architecture. This has to be defined, even if we decide for a hybrid thing. It's a matter of definition: yes, no, or both.

Marina Grinover:[4]
The collection is rich for being extremely diverse. It encompasses furniture, the house itself is a heritage, it has a collection of photographs, magazines, objects that are not exactly objects of art, such as the collections of handicrafts, in short, a universe of collections and subjects that interested the couple in those years that they lived in Brazil. This wealth could be one of the Institute's fronts of cultural action. It would be nice to hear from you which are the institute's fronts of cultural action.

Exhibiting architecture is a very legitimate front, one that is needed in our city, in our contemporary culture. Architecture can link together the museum, the Institute and the educational plans, in short, we could imagine it like a triad. The collection could be itinerant, as it is in the Whitney Museum, which varies the exhibition of its own collection. This kind of thing invites others to come.

Some [other fronts of cultural action] require a greater depth of research, of formulation. Like this one, that was not thought out of a collection list, but from a research project linked to the University of São Paulo [USP].

The Institute would better explain what lines of cultural policy are being formulated. Or that's what you want to discuss with us?

Mônica Junqueira de Camargo:[5]
What really constitutes this house as a house museum is that this sort of institution has to have its collection, which is a condition to be classified as such by the International Council of Museums (ICOM).

The Institute, with all its work of cataloging and preserving the collection, and now with this partnership with the Getty Foundation, has become a very specific one in this field. This enables it to become a national reference center, be it one for restoration of modern houses or for restoration of architectural heritage. A national reference center, either for courses or for training professionals in the preservation of collections, which could be subsidized by the state, or exploited for income. The Institute has already solved this question regarding itself. There are several houses that have this problem, be it house museums or not. And you already have that work here, and that would be a way of extroverting it.

Abílio Guerra:[6]
Following the thread of Mônica's statement, we have problems concerning conservation that are different from those faced by those American houses. When we launched the book on Rino Levi, we were invited to discuss the vocation of Casa Olivo Gomes in São José dos Campos, a concern that remains unresolved until today. We started a book on Hans Bross, and there is the Casa Hans Bross in

Anna Carboncini and Raquel Schenkman

José Lira

Ana Vaz Milheiros

Student in audience exposing his ideas

Morumbi, in an area with many slums nearby. Hans Bross declared in his will that this house was to become some sort of cultural equipment focusing on the architecture field. It was sent to the Department of Historical Heritage, to USP and Mackenzie University, no one was interested and did not even start to discuss the issue. It is a wonderful house and has the contributions of Burle Marx, both in objects and in landscaping. And we have the house of Oscar Americano near here, which for the sake of survival made adaptations that, to my understanding, greatly adulterate its architectural design. And we stand between the devil and the deep sea, the vital need is for the house to remain, but not at the cost of adulteration. There are other alternatives, such as the house on Bahia Street, by G. W. [Gregori Warchavchik], which has long been adapted for contemporary uses. It brings us to the theme that even a person's home is never the same over time. The children grow up, they leave the house, the rooms become a library, they host other people, the houses have life too and I see no reason for freezing it in time.

On the other hand, someone spoke of fetish, I do not see any problem in it, it's a lovely thing when you go to a place that has that aura too. I remember with special affection the visit to the house of Pablo Neruda in Chile, to see the objects contaminated by time, by the experience and the appropriation. And this should not be overlooked. The house has a vocation, today the house holds an exhibition that relates it to other houses. I agree with Monica, the Glass House can be a reference center for discussing the vocation of these modern houses that are aging. Some are being destroyed; others, such as the Casa Vilanova Artigas, which belongs to the family, are paying very high IPTU [Brazilian tax on realty], it is unknown how long they will resist. It is a topic to be discussed. There are issues regarding the environment, this place where the house is, this vegetation, which is a characteristic of modern Brazilian architecture, this relationship of the constructions with the landscape. [It's necessary] To think of a hybrid solution, between maintaining this fetish of the house where the couple lived, but at the same time [being] plugged into contemporary issues.

José Tavares de Lira:[7]
I congratulate the Institute on the initiative, because, without discussions like this, the collection remains worthless, no matter how important it may be.

Basically, I see the Institute with these two great forces, its architecture, its artistic heritage and memories that the house brings together; and a cultural project, without which this collection remains dormant. They must be faced with synergy, but recognizing that they have their own specificities and demands.

The architectural exhibition, not specifically this beautiful and small architectural exhibition [held here now], which suggests different looks at the building – one sees the exhibition and walks around the house –, despite this, the architecture exhibition has very specific issues. There is no better exhibition of an architecture work than visiting the building itself. No matter how much a drawing, writings of the architects or videos bring additional elements, it leaves the gap of the building, of the monument itself, it is something that places very specific layers of fruition. When you bring this exhibition function to a building of this importance, you must negotiate with this dimension of the space. It is not an exhibition space whatsoever and it was not meant to be an exhibition space. What kind of exhibition [will be held] in a space like this, that has this overload of memories. Of all these houses shown in the exhibition, this is the most deeply inhabited and modified, with accumulation of life. Maybe only Eames' might be comparable.

Perhaps [it would be possible] to alternate between different types of temporary exhibitions, of its own collection or recomposing situations close to the original. It is necessary to review the house in some way close to the one that made it known. In a country that does not have this practice of preservation, this is one of the few successful modern houses that functions as a space for research, storage, and exhibition. Take the case of the Casa Warchavichik, which was listed. It was expropriated and is part of the collection of houses of the city hall, but does not have a cultural project, has no collection other than itself. The indigence of these institutions gives a centrality to this institution that is fundamental.

The list could still include Casa Canoas, Casa Carmem Portinho.

Sonia Amaral:
Every time you have an exhibition, you see the house in a different way. This purity impoverishes, prevents the issue of the return of the house to what it was as well as that of seeing the house from new angles. As it happened in Bechara's exhibition, where the panes of glasses created prisms that had never existed before.

Fernando Tulio:[8]
The Institute rescues the house as a vertex of the city.
In a debate put in terms of cultural policy, it is central to devise the perspective of structuring a network. This power will not come from an isolated cultural political project, from a house, a school, the FAU [Faculty of Architecture and Urbanism of USP] or the IAB [Institute of Architects of Brazil]. We started the IAB thinking of it as a platform for culture, public policy, teaching and extension, and professional.

There is no such network dimension for these institutions to make such discussions. Think together initiatives such as the Biennial, the routes through the city, which could be organized here, some others in the center, others in the periphery. Networking allows us to acquire power in this difficult time for the city and for the profession.

In what concerns culture, we have two perspectives. One that is to structure the observatory with two axes: on the one hand, one focusing on architecture and, on the other, the laboratory, divided into a drawing workshop and public policies. And it has the prospect for 2020: with the UIA, the PMR proposed to debate the territory from the infrastructure network, not only in local terms, but in terms of a network of cities. How to create a practice in which each institution preserves its own policy, but at the same time joins the others in this network?

Felipe Contier:[9]
Fernando Tulio and Abílio retrieved the idea of a network of houses articulated by the IAB, with a mapping already done.

But it is necessary to highlight the different maturity of this project for each of these houses. This house, the Glass House, is far ahead, it is the vanguard, for the role played by the couple in having taken the initiative still in life. Part of his vocation is to articulate this network, to teach the other houses how to preserve their collections, to structure what we have here as a living house with a collection and care that we see here.

The second point is the architecture exhibitions. We are experiencing the growing problem of documentation, custody and research in architecture. The library of FAU/USP has refused many collections due to lack of physical capacity. Once in a while the idea of a reference center for the documentation of Brazilian architecture comes up, withf collections of national level made available for research.

Here in the Glass House we see a specialization of documentation and research center. Even whilst closed for visitation, it served as a support center for researchers. It had great projects of financing the organization of the collections. It has a know-how in this field of projects that other institutions do not have. On the one hand, [there are] the number of collections that do not stop growing. On the other hand, [there are] the houses that remain and could be used for this.

Training the next houses to receive these collections of projects. Forming a constellation of houses of architects that can receive collections and function as centers of support for research, with its curatorships, perhaps articulated by the IAB.

Raquel Schenkman:[10]
This network of houses... Thinking as a representative of the Secretariat of Culture [of the São Paulo City Hall], they all have common problems, such as [paying its] IPTU, financing, accessibility approval. There are institutions that are making plans in the long run. If networking happens, along with the owners, the experience could be shared. We are completing the declaration of the heritages that were waiting to be done in the DPH [Department of Historic Heritage of São Paulo City Hall] and there will be a special meeting of the Conpresp [Municipal Council for the Preservation of Historic Heritage] to evaluate several proposals for declaring constructions of Modern Architecture as historical heritage sites.

We have the examples of the clubs that act differently. The Paulistano Club had an interest in declaring its gymnasium, designed by Paulo Mendes da Rocha, as a heritage building, taking advantage of the incentives for such buildings. Meanwhile, the Pinheiros Club resists declaring its assembly room, designed by Warchavchik, as a heritage site.

The Modernist House has long been empty, with no collection, no money, no complete project. And the Secretariat has no capacity to formulate this project. Then one speaks of granting the house or even selling it.

It could be the role of this network of houses to gather more strength to preserve themselves as a whole. The network can even help demanding funds – the declaration of heritage helps to get public resources and tax incentives. It can give greater strength to publicize the site and obtain resources for it.

Exhibit Glass Houses
Displays by Marina Correia
Instituto Bardi, 2017/2018
Photo Marina D'Imperio

Exhibit House of Wind, Lucia Koch.
Instituto Bardi, 2019, Photo Renato
Anelli

João Sodré:[11]
I think of possible exhibitions in the Glass House, the exhibition in the room, these exhibitions involving production, research. What are the restrictions on exhibitions with objects kept in the collection? For example an exhibition of Nervi's structural design in relation to the construction of the house.

I think of three types of exhibitions. Those that require more resources and use material from other collections, those made only with items from the collection itself, and the exhibition of the room set up as a room.

An exhibition such as the one presently held here allows one to reach corners that were previously not accessible because they were occupied with furniture, allowing for new insights. Every visit to the house is a new experience. For example, only today I realized that its roof is not in two slopes, but domed.

Ruth Verde Zein:[12]
The House has always been our friend. It has always accepted the proposals from Docomomo SP, as [occurred] in last year's visit. The houses are pilgrimage sites. Visits to modern houses in the world are different because they have a side of structured business, with expensive tickets and great demand. Here, the house does not have it yet, and it is more friendly.

I want to reinforce the idea of bringing here events, courses, etc. which could be made pro bono by us and other colleagues.

Docomomo SP would like to help organize these events, so that the house can earn some revenue.

Ana Vaz Milheiro:[13]
As a foreigner, although very much in love with Brazilian things, I think there should be a recentralization of Lina's figure, who is an internationally prominent person that brings a brutal interest in her work and her speech. On the other hand, there is the reality that the architectural production of Lina is not so vast as that of other architects from São Paulo.

Lina's work is very important to the city of São Paulo, but it is scarce. Since it is scarce, the Glass House has a greater responsibility in recentralizing the discourse in its work, through its study, research, etc. Contrary to opening it, I thought it should be closed, in this sense of protecting the figure of Lina of being trivialized. Today there are three or four buildings by Lina in the city that people experience a lot, Masp, Sesc [Pompeia], Teatro Oficina, and this house. I would say that one must value this question, of how Lina put herself in the city that she chose to live in.

But when people come to Lina's house, especially someone who comes from abroad, they expect to find Lina's house. They don't expect to find Lina's house colonized by other things. I think it is a responsibility, after all, that anyone who is in head of the curatorship for such a space must have clear. Because sometimes exhibitions – no matter how well-intentioned they might be – can be scandalous to the house. Any exhibition that takes place here has to be done with care, with a degree of intentionality, with research, with a program. The space requires tweezers to cope with. [Otherwise] What we want to be a valid architectural experience can become a failure. There is an expectation that today Lina brings in international terms, which those who visit this house expect to be reciprocated. When I arrived in Brazil many years ago, there was a very strong and very heated debate about the restoration of the integrity of the Masp museum space. Now that the space has been recovered, it is a great emotion to see what Masp can give us, besides the collection that is there, that project that Lina had of how to show art.

No matter what is decided to be done here, we have to think hard about what we would be sacrificing, because a house is a house, a house is not an art gallery, a house is not a museum. A house has to undergo transformations, but it's a house. And when people visit the house, they expect to find a house. Even if there are gaps. It is not important that the old table is there or not. No house we visited has its complete original collection, as keeping it would be crazy. I wanted to thank you for this opportunity to be here and to say that you are sitting in a gold mine, it's Lina's house, it's not any house. That alone is already a starting point to which anything else may follow but success.

Sonia Amaral:
Do you mean the preservation of the aura of the house?

Ana Vaz Milheiro:
Yes, the aura of the house. It is essential that you get here and do not become disappointed.

There is a typology of house visitors who only go once. There are people who only go once to a museum. We have to create new audiences, but we cannot be too hostage to this, we have to think about Lina's architecture. What's important is Lina, that's what it can show.

1 The exhibition was sponsored by the AGC glass company, by means of a special program of the Government of the State of São Paulo to support culture. It gathered Philip Johnson's glass house in New Canaan; Farnsworth, by Mies Van Der Rohe; [the House] Eames and the House Bardi. During the event two debates were held: one with the curators of the houses, on October 10, 2017, and other in the Glass House studio, on February 25, 2018. Available at: https://www.facebook.com/projetomarieta/videos/1521041558024035/?fref=mentions

2 Alvaro Puntoni: Architect and urbanist with a doctorate degree from FAU/USP, where he is a professor. He is also a professor at the Escola da Cidade, where he coordinates the Specialization Course in America. He is na associate of the architecture office Grupo SP.

3 Marta Bogea: Architect and urbanist from the Federal University of Espírito Santo and with a doctorate degree from FAU/USP, where she is a professor and coordinator of the Architecture and Urbanism course.

4 Marina Mange Grinover: Architect and urbanist with a doctorate degree from FAU/USP, professor of projecting at FAAP (Fundação Armando Alvares Penteado) and at Escola da Cidade. Na associate of the architecture office Base Urbana. Visiting professor at MIT (Massachusetts Institute of Technology) (2018).

5 Mônica Junqueira de Camargo: Architect and urbanist from Mackenzie University with a doctorate degree from FAU/USP, where she is a professor. She was director of the Center for Cultural Preservation of USP and advisor to Conpresp.

6 Abílio Guerra: Architect and urbanist from PUC (Pontifical Catholic University) of Campinas with a doctorate degree in history from Unicamp (State University of Campinas). Professor at Mackenzie University, he is the editor of the website www.vitruvius.com.br and the publisher of Romano Guerra Editora.

7 José Tavares de Lira: Architect and urbanist from the Federal University of Pernambuco with a doctorate degree from FAU/USP, where he is a professor of architecture history. He was director of the Center for Cultural Preservation at USP.

8 Fernando Tulio: Architect and urbanist from FAU/USP. He is president of the São Paulo Department of the Institute of Architects of Brazil.

9 Felipe Contier: Architect and urbanist from FAU/USP, with a doctorate degree from the Urbanism and Architecture Institute of the University of São Paulo (IAU/USP) and a professor at Mackenzie University. Architect of the Contier Architecture office.

10 Raquel Schenkman: Architect and urbanist from FAU/USP, where he also got his doctorate degree. Director of the Department of Historic Patrimony of the City of São Paulo.

11 João Sodré: Architect and urbanist from FAU/USP, where he got his doctorate degree. Professor at FAAP and at Escola da Cidade. Architect of the architecture office Grupo SP.

12 Ruth Verde Zein: Architect and urbanist from FAU/USP, with a doctorate degree in Theory, History and Critique of Architecture from the Federal University of Rio Grande do Sul. Professor at Mackenzie University.

13 Ana Vaz Milheiro: Architect from the Technical University of Lisbon, with a doctorate degree from FAU/USP. Professor at the University Institute of Lisbon.

5.2 Verification Report of Structural Capacity

Ricardo Couceiro Bento

1 Introduction

The present report is intended to verify the structural capacity of the construction, originally designed and used as a residential building, in view of its change of purpose, for the project of transforming it into a space for public visitation.

The work was envisaged as part of a historic heritage preservation project that received the support of the Getty Foundation through the third-edition of its *Keeping It Modern* program, which encourages the realization of historical asset management and maintenance plans drawn up from specialized technical studies.

According to item 1.2 (*Work Plan*) of the said project, it is necessary to evaluate the impact of the change of use on the construction and the maximum loads of the main building structure in order to minimize its deterioration.

The author of this work was defined by the coordinator of the task group three of the project, Professor João Adriano Rossignolo.

2 Study plan

Because of the change of use during the life of the building, the objective was to carry out the necessary verification of the existing structural components, in what regards the resistant capacity, due to the new loads requested from the point of view of safety and durability.

In order to perform the analysis of the structure aiming such goal, the following procedures were performed:

- Study and interpretation of structural design information,
- On-site verifications of structural components,
- Analysis of the design of the original structure with structural calculation software.

3 Study and interpretation of structural design information

The structural project analyzed was executed in 1951 by the company Sociedade Comercial e Construtora S.A. The existing draws are available at: <http://www.institutobardi.com.br/desenhos_simples.asp?Palavra_Chave=estrutura%20casa%20de%20vidro&Codigo_Referencia=&Data_Inicial=&Data_Final>. In spite of a good level of detailing in the drawings, it is observed, from their study, the absence of certain information of extreme importance for the project, such as the characteristic resistance of the concrete (f_{ck}), the type of steel used in the reinforced concrete structure (drainage tension) and the detailing of the columns constructed with steel pipes (without any information as to the wall thickness of the pipes and their interior). Due to this difficulty, additional investigations were carried out to make feasible the structural analysis of the residence, as described in item 4, below.

4 On-site verification of structural components

Measurements of the most important and accessible structural parts, such as steel-pillared columns, of the depth of the spread footings on the foundations of these columns, and of the thickness of the floor slab of the first floor were taken. Also, observances were made regarding pathologies that could express some damage or excessive deterioration of the structure, and no occurrence was verified.

In images 1, 2 and 3, it is possible to observe the hole made in a cylindrical column to verify the thickness of the steel pipe and the existence of concrete inside it. The measurement was 9.84 mm, and the pipe thickness of 10 mm was adopted in the analysis. Ultrasonography was also performed and, although it resulted in generally non-conclusive values, it showed a similar result with respect to the thickness of the pipe. The existence of concrete inside the metal pipe was also confirmed.

Image 1:
Hole in the column

Image 2:
Measurement of pipe thickness

Image 3:
Reading the thickness of the tube on the calipers

In order to verify the depth of the top of the columns spread footings in round steel pipes and the insertion of the pillars in the land, it was collected a sample through opening o holes in some of them, as seen in images 4, 5 and 6.

Image 4:
Location of the top of the spread footing

Image 5:
Location of the top of the spread footing

Image 6:
Location of the top of the spread footing

The thickness of the slab, as verified by means of prospection, using an outlet on the floor of the first floor, is of 58.15 mm, as shown in images 7, 8, 9 and 10.

Image 7:
Detail of outlet on the floor slab

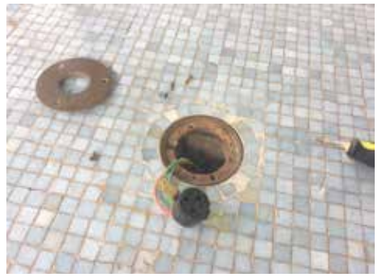


Image 8:
Outlet on the floor slab

Image 9:
Measurement of slab thickness

Image 10:
Reading on the calipers

As to the characteristic resistance of the concrete (f_{ck}) used in the construction, no data was found that would make possible the execution of a resistance projection over the years, necessary for the structural evaluation.

This data is, of course, of vital importance for the analysis of the reinforced concrete structure and, as a consequence of its absence, it was commissioned the extraction of concrete samples from the structure by a technical laboratory specialized in the procedure.

Due to the importance of this data for aesthetic preservation, and aiming at an investigation with a minimum of intervention, it was approved the extraction of specimens of the core structure of reinforced concrete with the diameter of 27 mm – the so-called smaller specimens, in substitution of the usual ones, with a diameter of 100 mm or 75 mm.

The use of the smaller specimens was theoretically possible and then adopted in the evaluation of the compressive strength of the concrete, since it was evidenced, based on the excellent statistical correlations at the significance level of 1%, the possibility of using them in the evaluation of finished structures (VIEIRA FILHO, 2007).

The extraction of the specimens was commissioned by Centro Tecnológico de Controle da Qualidade Falcão Bauer and followed the requirements of ABNT NBR 7680-1: 2015 – *Concreto – Extração, preparo, ensaio e análise de testemunhos de estruturas de concreto*. *Parte 1: Resistência à compressão axial* [Concrete – Extraction, preparation, testing and analysis of concrete structures. Part 1: Resistance to axial compression].

The work of extracting specimens and subsequent filling of the holes were supervised personally by the author of this report. The results of the tests are given in Annex 1 to this structural report.

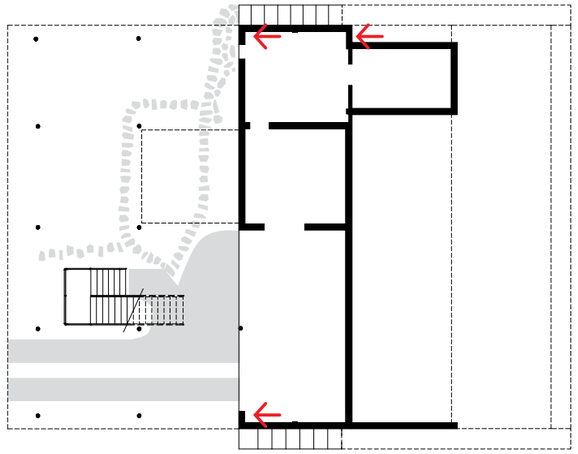


Figure 1:
Smaller specimens extraction points in the concrete structure

Still because of their relevance to the preservation of the building, 3 strategic points were approved for extracting the smaller specimens so that they were not overly visible (as indicated in figure 1), being two samples of each point, used to ensure the minimum number of 6 specimens required for a statistical analysis according to ABNT NBR-7680-1: 2015.

The process of extracting the smaller specimens can be observed in images 11, 12, 13.

A test was also carried out in order to verify the depth of carbonation in the concrete structure. This test was requested due to the great importance of this phenomenon, whose occurrence, in case it reaches the structure armature, causes structural damages due to the oxidation speed of the reinforcements. The result of this test is given in Annex 2 to this report. One stage of the test, using the phenohphthalein indicator, can be verified in image 14.

Image 11:
Smaller specimens extraction: detection of concrete cover with cover meter

Image 12:
Smaller specimens extraction: using a drill

Image 13:
Smaller specimens extraction: specimen extracted

Image 14:
Carbonation test: measuring carbonation depth

Later, it was found in Italy a detail by engineer Nervi, the structural consultant of the owners of the residence. The detail contained a specification in the design of the Glass House as to the minimum characteristics of the columns, such as the thickness of the pipes, the connections with the slabs and the foundations, as well as the minimum consumption of cement. In addition, a maximum load of 45 tons was also provided for the foundations, and the maximum load capacity of the soil was assumed to be as low as 1.5 kg/cm², resulting in a minimum size for the spread footings of 1.70 m x 1.70 m for the columns with metal pipes. The detail is in image 15.

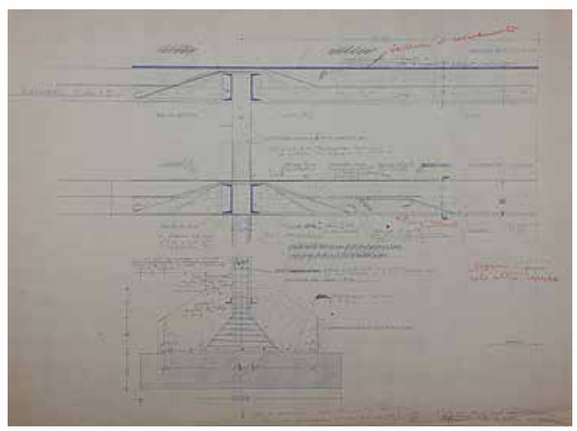


Image 15:
Photo of a detail of the design by the engineer Nervi regarding the Glass House, column bonds with the foundation and the slabs

4.1 Assesment of concrete strength for purposes of structural safety verification

According to FUSCO (2008), in general, since the number of specimens that can be effectively extracted from an existing structure is usually very small, it is usual to carry out only an unsystematic statistical analysis that encompasses the entire structure in a single batch.

NBR 7680-1: 2015, in its item 7.1.2, indicates that, for the assesment of concrete resistance to be used in the structural safety verification, it must be taken into account all the results issued by the laboratory responsible for the tests, already corrected by coefficients k1 to k4. The table in figure 2 was the one provided by the laboratory with the results of the tests.

Condição de estocagem: Exposto ao ar

Lote	CP	Nota Fiscal	fck (MPa)	Altura "h" (mm)	Diâmetro "d" (mm)	Tempo de Estocagem (horas)	Massa Especifica (kg/m³) *	Carga de Ruptura (N)	fci,ext,inicial (MPa)	k1 (Obs. 1)	k2 *** (Obs. 2)	k3 (Obs. 3)	k4 (Obs. 4)	fci,ext (MPa) **
	1	N.D	N.D	51,0	27,0	72	2.363	18.802	32,8	-0,009	0,1476	0,05	-0,04	37,7
	2	N.D	N.D	54,0	27,0	72	2.588	11.973	20,9	0,000	0,1476	0,05	-0,04	24,2
	3	N.D	N.D	53,0	27,0	72	2.472	15.309	26,7	-0,003	0,1476	0,05	-0,04	30,9
	4	N.D	N.D	54,0	27,0	72	2.426	17.703	30,9	0,000	0,1476	0,05	-0,04	35,8
	5	N.D	N.D	54,0	27,0	72	2.555	17.467	30,5	0,000	0,1476	0,05	-0,04	35,3
	6	N.D	N.D	47,0	27,0	72	2.453	16.898	29,5	-0,021	0,1476	0,05	-0,04	33,6

* Massa Especifica Aparente da Amostra
** Tensão de Ruptura Corrigida
*** O coeficiente K2 (Efeito Broqueamento) foi encontrado através da interpolação dos valores determinados na tabela 3 do item 5.2.3, considerando o valor de 0,15 para o diâmetro de 25mm.
Obs. 1: k1 = Coeficiente de Correção (Relação h/d)
Obs. 2: k2 = Coeficiente de Correção (Efeito Broqueamento)
Obs. 3: k3 = Coeficiente de Correção (Direção da Extração)
Obs. 4: k4 = Coeficiente de Correção (Efeito umidade)
Resolução da prensa: 10kgf.

Figure 2:
Table with test results of the smaller specimens of concrete

According to the same paragraph of the said standard, the estimate of the characteristic strength of the lot for purposes of structural safety verification is given by the average of the individual results of that lot, according to the following equation:

Also according to NBR 7680-1:2015, the design resistance f_{cd} to be used in the verification of the structure should be calculated using the $Đ_c$ reduction provided for in NBR 6118:2014.

For the assesment of structural safety and overall stability, considering the Ultimate Limit State (ULS), NBR 6118:2014, in its item 12.4.1, recommends, in the case of specimens extracted from the structure, the division of the value of $Đ_c$ by 1.1. Therefore, in usual cases, $Đ_c$ = 1.4 / 1.1 = 1.27, which is pragmatically equivalent to multiplying the result of resistance of the test by 1.1, ie increasing it by 10%, since the test better represents the effective strength of the concrete at the site around that extraction region than the molded specimen. For the purpose of verification of the Service Limit State (SLS), ie deformations (arrows), cracking and working stress, it should be adopted $Đ_c$ = 1. There is also no need to apply coefficients to retroact resistances at 28 days, because they are specimens extracted from elements under load (HELENE, 2010).

The current resistance under load, that is, already affected, is diminished in advance by the Rusch effect (loss of the resistant capacity due to long-term load of the material). Both actions, Rusch effect and resistance growth, are practically stabilized after fifty years (BOLINA, PERRONE and TUTIKIAN, 2015).

In the case of this study, these divisions of $Đ_c$ were not adopted by the author, due to safety reasons, given the possibility of extracting only a small number of specimens.

Thus, based on these works, on the normative specifications and on the conclusions of the tests, following the guidelines of NBR 7680-1:2015, the result reached was $f_{ck,\ ext,\ seg}$ of 32.92 MPa.

Later, one of the values of f_{ck} established by NBR 8953:2015 – the one closest to the concrete class of 30 MPa – was adopted, in favor of safety.

4.2 Assessment of carbonation depth for purposes of structural safety verification

According to the results of the report issued by the laboratory responsible for the tests, the structure is not carbonated in the region of the reinforcement. The covering of the columns tested is of 20 mm, according to the original structural design, and the coating is of 15 mm according to the on-site verification.

Carbonation was detected as varying from 0 mm to 10 mm, from the outer face to the center of the piece. In view of the obtained results, the laboratory responsible for the tests verified that the carbonate thickness has not yet reached the reinforcement of the parts and, therefore, the passive layer of the bars must be preserved where the concrete is intact. The results of these tests can be found in Annex 2 to this report.

5 Analysis of the structural design with software for structural design

With the information described in the previous items, the data of the design of the original structural design were inserted and analyzed in structural design software with the due and required modeling for a more realistic analysis, according to the possibilities of the tools.

The programs used were *CAD/TQS V18 System* (national reference in its field of activity, with clients throughout Brazil and in some other countries) for the determination of the efforts and verification of the details of the structure of reinforced concrete. The *Pilar Misto V&M-UFMG – Programa Pilar Misto*, which verifies steel tubular columns filled with concrete according to ABNT NBR 8800:2008, was used for the exclusive analysis of the composite steel and concrete round columns (this software was developed by the Federal University of Minas Gerais – UFMG).

The initial procedure adopted was the insertion of data in the *CAD/TQS V18 System* referring to the location and dimensions described in the original design.

In the structural analysis, besides the permanent loads (constituted by the weight of the structure itself and of all the fixed elements and permanent installations), it was also necessary to take into account the use of the building – no longer for residential purposes, as originally conceived, but according to the current purpose, which we could classify as a small museum or an art gallery – in the consideration of accidental overloads (accidental overload is everything that can act on the structure of buildings depending on their use, such as people, furniture, miscellaneous materials, vehicles, etc.).

Loads are important factors in the field of structural safety and life expectancy for the ultimate limit state criteria. Due to their random nature, the loads are difficult to define, especially accidental ones. The vertical loads considered to be acting on the floors of buildings, besides those that are applied in a special character, are assumed to be evenly distributed, with minimum values indicated. ABNT NBR 6120:1980 – *Cargas para o cálculo de estruturas de edificações* [Loads for the calculation of building structures] specifies these minimum values (JORDÃO et al., 2013).

The vertical overload adopted for the floor of the upper floor in this evaluation was 3 kN/m² (300 kg/m²), equivalent to an occupation of 42 people in 10 m² (MARINGONI, 2003).

This overload, as specified in NBR 6120:1980, provides for a minimum load to be considered for corridors and school classrooms, movie theaters with fixed seats, library reading rooms and, finally, for art galleries (considered appropriate in this evaluation). The configuration of the environment can be verified in some images, as in figure 3, which presents the modeling of the upper floor, and in figure 4, with 3D views of the complete structure evaluated in some models. The total loads resulting from structural processing are detailed in figure 5.

In the analysis of the space porch, for the displacement verification, it was considered a wind speed of 45 m/s.

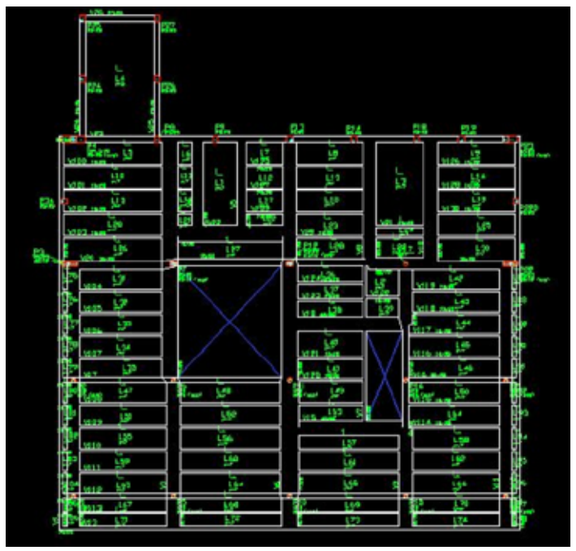


Figure 3:
Modeling of the upper floor in CAD/ TQS software

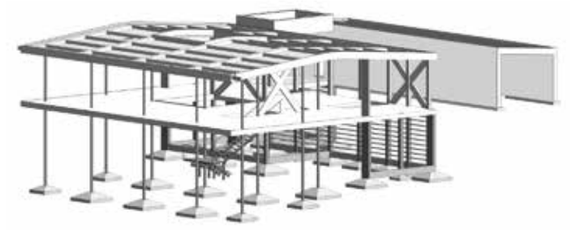


Figure 4:
3D view of structural modeling

Elem	Caso	FZ MAX–ELU2–Verificações de estado limite último – Pilares e fundações				MX MAX–ELU2–Verificações de estado limite último – Pilares e fundações				MY MAX–ELU2–Verificações de estado limite último – Pilares e fundações			
		Fz	Fz	Mx	My	Fz	Mx	My		Fz	Mx	My	
S1		14.3	14.3	0.0	−0.1	14.0	0.1	−0.1		13.8	0.0	0.1	
S2		18.8	19.0	0.1	−0.1	18.5	0.1	−0.1		18.1	0.1	0.1	
S3		20.4	20.8	−1.5	−3.8	20.1	1.0	−0.7		19.5	−0.1	7.0	
S4		19.3	19.5	−0.5	−5.6	19.0	2.9	2.9		18.8	1.3	14.2	
S5		26.5	26.6	0.1	0.1	25.5	0.2	0.0		25.5	0.1	0.1	
S6		24.5	24.6	0.0	0.1	23.6	0.1	0.1		23.5	−0.1	0.3	
S7		35.2	35.3	1.7	1.4	34.1	2.5	1.0		34.5	1.7	1.6	
S8		19.8	20.0	−0.1	0.5	19.7	0.2	0.5		18.8	−0.4	0.7	
S9		13.6	14.4	0.2	0.5	13.5	0.7	0.3		14.4	0.2	0.5	
S10		27.0	27.0	0.2	0.0	26.0	0.2	0.0		26.0	0.1	0.1	
S11		24.5	24.5	0.0	−0.1	23.6	0.1	−0.1		23.5	−0.1	0.1	
S12		37.4	37.5	−0.9	−2.4	36.8	−0.6	−2.4		36.5	−1.6	−1.9	
S13		20.5	20.7	1.6	0.1	19.3	2.9	0.1		19.8	2.1	0.3	
S14		11.5	12.1	0.3	−0.2	11.5	0.8	0.0		10.8	0.1	0.1	
S15		25.1	25.1	0.1	0.0	24.2	0.1	0.0		24.0	0.0	0.1	
S16		28.3	28.2	0.2	−0.2	27.0	0.3	−0.2		26.9	0.0	0.2	
S17		31.6	31.7	0.0	0.0	30.1	0.1	0.0		29.9	−0.1	0.1	
S18		13.9	14.0	0.1	−0.1	13.3	0.9	−0.2		13.5	0.0	−0.1	
S19		7.6	7.8	0.3	0.0	7.5	0.9	0.1		7.4	−0.1	0.3	
S20		15.6	15.7	0.0	0.1	15.3	0.2	0.0		15.3	0.0	0.2	
S21		20.7	20.9	0.2	0.1	20.4	0.3	0.0		20.1	0.0	0.2	
S22		19.2	19.5	−1.4	5.4	18.9	2.4	0.3		19.1	−1.9	8.0	
S23		7.7	8.4	0.1	4.0	7.0	3.4	1.1		8.4	0.1	4.0	
S24		7.6	7.6	−0.3	0.0	7.3	0.9	0.1		7.3	0.4	0.1	
S25		7.9	8.3	−0.2	0.9	7.3	1.1	1.1		7.3	1.1	1.1	
S26		7.4	7.4	0.4	−0.1	7.2	1.3	0.0		7.2	0.8	0.1	
S27		7.9	8.2	−0.2	−0.9	7.4	1.2	−0.7		7.4	1.2	−0.7	
S34		8.3	8.3	−0.1	−0.3	8.1	0.9	−0.2		8.0	0.5	0.1	
S220		8.3	8.4	1.1	0.2	8.2	1.5	0.2		8.1	−0.1	0.4	

Observações:
1 = Esforços com valores característicos
2 = Forças em tf
3 = Momentos em tfm
4 = Sistema de coordenadas GLOBAL

Figure 7:
Table of the columns loads

5.1 Analysis of the spread footing foundations

Through the results obtained in the structural modeling applied to the dimensions of the foundations, presumably executed according to the detail of the structural design, dated 1951, in its sheet 1, it can be observed an average transfer of tensile force to the ground of the order of 0.076 MPa (0.76 kg/cm²), varying from a minimum of 0.039 MPa (0.39 kg/cm²) to a maximum of 0.114 MPa (1.14 kg/cm²). In the specific case of the foundations of the composite steel and concrete columns supporting the upper floor slab, the average tension transferred to the ground was 0.089 MPa (0.89 kg/cm²), ranging from a minimum of 0.08 MPa (0.8 kg/cm²) to a maximum of 0.114 MPa (1.14 kg/cm²).

The detail of the project by Nervi, in image 11, indicates the consideration of a load capacity of the soil for a tension of 0.15 MPa (1.50 kg/cm²), which may suggest the occurrence of some discussion in this sense between the Brazilian designers and the Italian at the time of designing the structural project.

Results of soil load capacity gotten through trials, performed currently or at the time of construction, are not available. However, based on the observances made on the foundations and on the structure of the house, together with the data of the original projects and these, compared to the results of the loads of the current structural project, the conclusion is that, with respect to the foundations for the intended use, these are safe in what regards the requests.

5.2 Analysis of the columns

5.2.1) *Composite steel and concrete tubular columns*

The composite steel and concrete tubular columns were evaluated for the requirements obtained in the structural modeling with the measurement of the dimensions taken on-site. The variation of the heights to the foundations was taken into consideration in the structural analysis according to the situation of each column measured on-site.

The values used for the analysis, in the case of the columns that support the slab of the upper floor, were 18.3 cm for the diameter and 1 cm for the thickness of the pipe.

In no case was the contribution of any internal reinforcement, besides the concrete filling, considered for the analysis of the composite steel and concrete tubular columns. The existence of reinforcements in the concrete was not found in the details of the projects nor was it detected by means of ultrasound tests carried out on-site. For safety, it was decided to disregard them in the analyzes.

The calculation for the verification of these columns is regulated by ABNT NBR 8800:2008 – *Projeto de estruturas de aço e de estruturas mistas de aço e concreto de edifícios* [Design of steel structures and mixed structures of steel and concrete for buildings] (even if there is a specific standard for circular tubular profiles, ABNT NBR 16239:2013 – *Projeto de estruturas de aço e de estruturas mistas de aço e concreto de edificações com perfis tubulares* [Design of steel structures and mixed steel and concrete structures with tubular columns).

Since information related to the steel flow limit (f_y) of the columns is not available, the value of 180 MPa has been adopted to f_y, although NBR 8800:2008 does not consider in its Annex A flow limits lower than 250 MPa.

In practice, steel with f_y in the range of 180 MPa to 200 MPa can still be found on the market. This conservative value was adopted for the sake of safety, because it was considered closer to the characteristics of the pipes manufactured at the time of construction of the building.

The columns were evaluated through two calculation models, the calculation model I (based on the American Standard ANSI/AISC 360–05 – *Specification for Structural Steel Buildings* and uses the same expressions of interaction between axial force and bending moments prescribed for steel columns) and calculation model II (a verification based on the simplified method of European standard EN 1994–1–1:2004: *Design of Composite Steel and Concrete Structures – Part 1-1: General rules and rules for buildings*).

Some studies have shown that the calculation models I and II present adequate safety, and that for columns with relatively low slenderness and small contribution factor of steel, the calculation model I is quite conservative in relation to the calculation model II, and that, for columns with high contribution factor of steel or great relative slenderness, both models provide close results (CALDAS et al., 2007).

The evaluation of the existing composite steel and concrete tubular columns subjected to the structural modeling requests generated results that confirmed the structural safety of these pieces as to the intended use, object of this work. The results of this evaluation can be verified in Annex 3.

5.2.2) *Reinforced concrete columns*

The original structural design, in what regards the columns, only details the grade of the starters, described in sheet 2 of the original 1951 design. For the verification of the internal reinforcements of the columns, the only reference used was this information regarding the starters, with the deduction of continuity of the reinforcement to the upper floors.

Through the observance of the results of the structural modeling of the columns in reinforced concrete, the supporting columns of the floor slab of the upper floor are all in accordance with their dimensions and slenderness. Still with respect to the internal reinforcement (starting from the hypothesis of the existence of the same structure as of the starters), it attends to the current modeling in practically all the columns, as well as the longitudinal reinforcement and the stirrups.

The columns that did not respond to the new modeling were:

- P23, with original longitudinal reinforcement at 37.5% of the new modeling;
- P23, com uma armadura longitudinal original a 37,5% of the new modeling;
- P7, with original longitudinal reinforcement at 68,75% of the new modeling;
- P22a, with original longitudinal reinforcement at 37,5% of the new modeling.

As for the support section of the column cover in reinforced concrete, due to the various changes of the technical standards over the years, some have, as expected, dimensions smaller than the current minimum requirements.

The P3, P7, P12 and P22 columns have the smallest transverse dimension with 12 cm, whereas the requirements in NBR 6118:2014: *Projeto de Estruturas de Concreto – Procedimento* [Design of Concrete Structures – Procedure], in its item 13.2.3, determines a minimum of 14 cm.

A sizing coefficient is stipulated by NBR6118 in the case of columns with the smallest transverse dimension of less than 19 cm. For the analysis, the value of 1.5 was adopted (in the same standard, in its 2003 version, the value was 1.25, so the value adopted is in favor of security).

The current standard also does not allow, in any case, columns with cross-sectional area of less than 360 cm². The P7 and P12 columns, with a cross-sectional area of 230 cm², do not therefore meet this requirement in the supporting section of the roof.

5.2.3) *Circular reinforced concrete columns that support the roof*

The lack of detailing of the circular columns throughout the building has already been commented on previously, and the analysis of them is always difficult to achieve. Due to this difficulty, observations and conclusions were drawn through quantitative assessments reinforced by unavoidable qualitative assessments (supported by on-site observances of possible signs of structural pathologies).

According to information from the architect Marcelo Suzuki, the circular columns in the supporting section of the roof, contrary to what was thought, are not made of metal pipes filled with concrete, as they are in the supporting section of the floor of the pavement. The circular columns in the supporting section of the roof would then, according to this information, be made of asbestos cement, filled with concrete and reinforcement grade (unspecified as to its grading area or number of bars).

Observations and conclusions drawn by the author of this report through the available information:

1) The circular columns of the roof have a diameter of approximately 15 cm, which results in a cross-sectional area of 177 cm². The current standard, in NBR 6118: 2014: *Projeto de Estruturas de concreto – Procedimento*, in its item 13.2.3, states that in no case are to be allowed columns with a cross-sectional area of less than 360 cm². The columns meet the current standardization, with regard to the area of the minimum cross-section, in practically 50%.

2) For the verification of the nominal structural capacity of these columns, the following parameters were considered:

2.1) The conclusions and values obtained regarding the concrete strength were used, as explained in item 4.1. The exception was the adoption, in this case only, of the division of $Đ_c$ in the analysis of these columns, given the observance of the good conditions of the same, in order to avoid an assessment that is too pessimistic and probably out of reality.

2.2) The requests found in the current structural model with regard to vertical loads and moments in the columns.

2.3) The analysis was made based on the hypothesis that 12 mm # 12 mm reinforcement was installed on each columns, according to a detail of the design by the engineer Nervi in his guidelines for the execution of the structure, with the columns connections with the foundation (cited in image 15).

3) From the analysis of the results it is concluded that the circular columns P1, P5, P10, P15 and P20, from the first row from the façade, and the P2, P6, P11, P16 and P21 columns from the second row attend to structural capacity when it is taken into account the efforts, in their axes, of the vertical concentrated loads.

On the other hand, when the possible moments in their tops (obtained in the current structural model) are inserted, the columns would not meet the safety coefficients in all cases. The percentage of attendance of the safety coefficient would be, in the first row: P1, in 72%; P5, in 45%; P10, in 45%, P15, in 45%; and P20 in 84%. And, in the second row: P2, in 73%; P6, in 62%; P11, in 56%; P16, in 49%; and P21 in 91%.

4) The conditions of the structure as a whole, and specifically those of the circular pillars, observed on-site, despite the negative results listed in item 3, do not present any sign of pathological symptoms or excessive deformations (resulting in small values, according to structural model).

The current presentation of the structure in such good condition may be the result of factors such as the non-transfer of these moments to the top of the columns, according to the evaluated model, due to the behavior of the structure in a differentiated way in work. One hypothesis would be that this is due to the slow deformation of the columns or deformations of thermal origin of the cover slab, which would have unlinked the top of them from the roof beams. The cracks would have been repaired over time, not receiving the transfer of these moments.

Another hypothesis of differentiated behavior was the failure to consider the role played by the "X" locks presented in draw 12 of the original structural design of the Glass House, located between columns 7 and 12; 18 and 23, in the transverse direction; and between 16 and 17 in the longitudinal direction. These may have been part of an effort in the project to reduce horizontal movements. In the present structural model, without these locks, the horizontal displacements resulted in a maximum value of 0.27 cm at the top of the building (reference value of 0.56 cm) and a displacement between floors of 0.15 cm (reference value of 0.37 cm). The displacements are therefore within acceptable limits. It should be noted that low and lightweight buildings can dispense with the special bracing elements, since the main aporticated structure itself is sufficient to guarantee indeslocability (ARAÚJO, 2014).

Thus, unfortunately, the author of this report can not provide a reasonable and complete conclusion regarding a definitive and convincing evaluation of the current structure of the circular supporting columns of the roof. This would require further studies, testing and documentation analysis.

5.3 Assessment of slabs, ribs and beams of the upper floor and roof

The structure of the floors was modeled with the dimensions of the original design, and the deformations were evaluated by means of the non-linear grating process.

In the non-linear grating process, the portion referring to the creep of the concrete structure (phenomenon of gradual increase of the deformation over time under a given constant stress level) was not taken into consideration, since the structure was already stabilized after more than 60 years under load. Research with test results shows that in 75% to 80% of cases this occurs in the first year of construction (MEHTA & MONTEIRO, 2008), which justifies the hypothesis adopted.

The detailing of the ribs and beams was originally made with folded steel longitudinal reinforcements, usual at the time. For a long time the bars bent at 45° were considered the most recommended reinforcements to resist the tensile stresses caused by the shearing action. Nowadays, it is known the notion that a bent steel bar that passes from the trammel drawn to the compressed flange of the beam ensures a better connection between the two flanges of the parts, which would make it the best type of shearing reinforcement (FUSCO, 1995). In the present modeling of the structure, the verification of the shear stress was realized through the use of vertical stirrups.

As for the deformations of the structure through the non-linear grid, they are within the parameters of the standard for both slab and beams, proving adequate for the intended use.

The dimensions of the pieces (beams and ribs) were confirmed in the current modeling. Regarding the detailing of the reinforcement, some variations were observed as expected. The differences in structural parts (beams and slabs) are, depending on the case, more or less, but, in the opinion of this expert, they do not express anything that results in damage or a reprobation of the structure.

6 Assessment of displacements of the space portico

The average load obtained through the current modeling was 9,600 kg/m². The overall stability parameter obtained was an alpha value of 0.65 (reference value: 0.6).

The horizontal displacements resulted in a maximum value of 0.27 cm at the top of the building (reference value: 0.56 cm) and a floor displacement of 0.15 cm (reference value: 0.37 cm). Displacements, therefore, are within acceptable limits.

7 Final conclusions

The conclusions drawn from the studies carried out with the use of structural analysis software, from the on-site structure verifications (visual and obtained through the extraction of specimens) and from the existing projects are as follows:

· The structure is in a satisfactory state of conservation, given the age of the construction, and the carbonation process has not yet reached the reinforcement of the concrete structure.

· With regard to the Ultimate Limit State (ULS), obtained by comparing the current analysis with the original structural design, according to the details and hypotheses adopted in the evaluation, the structure is considered safe for vertical accidental overload in the floor of 3 kN/m² (300 kg/m²), which equals an occupancy of 42 people in 10 m². Regarding the detailing of the reinforcement, some variations were verified, as expected, which are not significant to the point of non-approval of the structure.

· Based on the observances made in the foundations and the structure of the house, together with the data of the original projects and these, compared to the results of the loads of the current structural project, the conclusion is that, with regard to foundations, these are safe in what concerns the requests for the intended use.

· The assessment of the existing composite steel and concrete tubular columns, submitted to the structural modeling requirements, presented results that confirmed the structural safety.

· By evaluating the results of the structural modeling of the columns in reinforced concrete, the supporting columns of the floor slab of the upper floor are all in accordance with their dimensions and slenderness.

· With respect to the State Service Limit (SSL), values of structure displacements and deformations of the beams and slabs (through non-linear grid analysis) were found within the limits of the current standardization.

With no more to add, I hereby endorse this report,

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5.3 Glazing report

Osny Pellegrino Ferreira

The facades' existing glass casements, comprised of steel profiles, are fixed to the lower slab (ground) and on the upper inclined slab (ceiling). Considering this rigidity in both slabs, it can be supposed that any movement occurring in these structural elements ends up generating force for the glass casements.

Cracks in the glass panels may have originated in the following manner:

1) Deformation due to fluidity in the reinforced concrete-- mainly in the centers between supports and in the extremities, where the roof and ground slabs find themselves in balance (from the columns), displacement due to the flexure of the slabs contributed to the generation of force in the casements, though in the present case it is considered less responsible for the cracking of the glass since the presence of cracks was not detected in the windows of the central casements between columns.

2) Movement resulting from thermal variation acts on the reinforced concrete structure and the casements. The roof slab is more subject to thermal variations, since it gains and loses heat from the environment with greater intensity than the ground slab. The glass is fragile and its coefficient of thermal expansion is much lower than that of concrete. This condition, considering that the casements are currently rigidly embedded (soldered) into both slabs, the differential thermal variations tend to cause shearing force in the glass, leading to cracks.

Aggravators that contribute to the occurrence of the cracking glass:

1) The attachment of the windows to the casements with putty - this material, composed of plaster and linseed oil tends to harden over time, turning stiff and passing any deformation that may occur in the metal frame on to the glass. The plaster (calcium sulfate) can also attack the steel profiles of the casements and, in the presence of humidity, lead to the appearance of rust (oxidation). The corroded steel presents volumetric expansion and can thus burden the glass panel, framed by the casement, exerting localized forces. The glass, a fragile material, should it surpass its resistant capacity can break at the more susceptible locales.

2) The rigid embedding of the casements- the profiles that comprise the casements are directly "soldered" into the ground and roof slabs and, as such, they are submitted to the deformations and displacements of each, both in terms of mechanical forces as well as those originating from variations in temperature in the environment.

Possibilities for the attenuation of the effects that contribute the cracking of the glass:

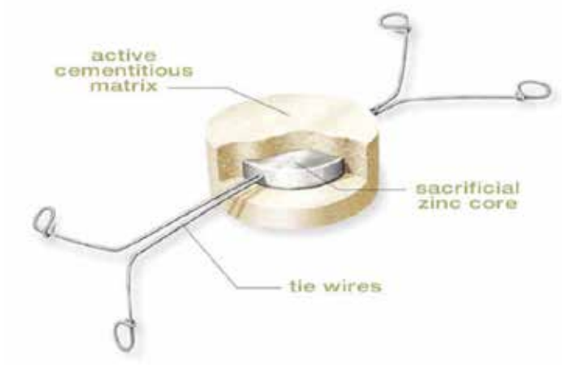
1) The substitution of the casements which are currently damaged - considering that the substitution of the already--corroded casements is necessary, the possibility of utilizing steel profiles that are resistant to corrosion can be verified, in other words, weathering steel, of the COR-TEN A type (designated as ASTM A 242), available on the market, used in architectural applications. This possibility will diminish corrosion in the steel casements.

2) Substitution of putty- application of elastomer to the base of flexible polyurethane in order to attach the glass to the casement. This solution is advisable since, in addition to preventing the oxidation of the steel, it guarantees greater impermeability and makes it possible for the glass to not receive occasional forces that originate in the casements.

3) Direct detachment of the casement from the structure – I consider the direct inlaying of the casements to the ground and roof slabs, by way of rigid anchor bolts, to be inappropriate in the present case. The possibility of desoldering the casements from the elements of reinforced concrete can be realized through flexible elements comprised of a UHMW (Ultra-High-Molecular-Weight) polymer (manufacturer Baron: http://baron.com.br/ company from Água Vermelha – São Carlos). This polymer is also resistant to electrochemical conduction and has a great capacity for resilience, which contributes to a longer lifespan for the casements.

4) Installation of galvanic anodes – the placement of "sacrificial" zinc pellets in order to minimize the corrosion of the steel and act as an alternative to the casements that are not yet completely compromised by oxidation. In them, the formation of flaking compromises the functioning of the casements and the movement of their moving parts where there are openings for ventilation, for example.

5) Substitution with laminated glass- the possibility of substituting with laminated glass appears adequate, considering that this type is considered safety glass, and it provides a greater guarantee in terms of the occurrence of accidents occasioned by falling fragments of glass that may happen to crack.



Example of "sacrificial" anode, zinc pallets that can be installed in the Casa de VIdro to prevent oxidation of the frames. This kind of anodes are attached to the metalwork of the reinforced concrete beam and can be installed in the space of the alveolar slab.

In terms of the item – Roof, I suggest that all tiles be replaced by corrugated sheets of asbestos cement without asbestos, with minimal thickness of 6 mm. To mitigate the thermal load provided by the roof I suggest that an isolating, plastic thermal film, such as Duralfoil, be applied, aluminized on both sides.

The existing glass wool batts should be removed, with workers taking great care and using personal protective equipment.

The orientation ratifies the recommendation made by team 3, coordinated by Professor João Adriano Rossignolo, PhD: substituting the roof tiles with the same characteristics, but without asbestos.

Installation of a lifeline on the roof in order to prevent maintenance workers from suffering falls or accidents.

Make coupled gutter

Circular pilotis

Measured by acoustic instrument (to detect the thickness of the metallic side wall).

In the base: remove the land up to 40 centimeters below the surface, scrape, sand the section with corrosion, apply phosphate coating (using Fosfatox) to the region and repaint with polyurethane bi-component based products. At the top, sand and repaint using synthetic enamel.

Painting

To regulate the mortar in the masonry, add to the lime 20% of acrylic latex, in terms of the quantity of water. This would give a greater regularity to the plaster covering the walls, avoiding fissures in the actual painting.

Gutter / gargoyle

Recompose the gutter according to the original project and coat it with a sheet of zinc, closing the openings with Sicaflex/polyurethane. Place dome drain covers over opening to the gutter's (downward) water chutes.

Osny Pellegrino Ferreira

Civil engineer (1975), retired professor from the University of São Paulo's São Carlos School of Engineering, having taught graduate and post-graduate courses in civil engineering and architecture and urbanism. Researcher in the area of civil construction and technology of the constructed environment on the following themes: special concretes, asbestos cement, the utilization of agro-industrial residues in construction, development of new materials and constructive components, evaluation of systems and constructive components, composites in polymeric and cementitious cores, structural reinforcements with fiberglass plating.

5.4 Casa de Vidro point cloud and information processing[1]

Júlio César Franco Jr.
Ana Regina Mizrahy Cuperschmid
Márcio Minto Fabricio

3d documentation and architectural heritage

Digital technologies are widely used for recording and preserving information concerning architectural heritage. Virtual reconstruction of historical building allows innovative possibilities for recording the memory of buildings and their construction techniques, which may contribute to maintenance and operation actions.

This chapter presents research results on the implementation of digital technologies for documenting architectural heritage carried on in Lina Bo Bardi's Casa de Vidro [Glass House]. The documentation work used Terrestrial Laser Scanning (TLS) and photogrammetric techniques to support the development of HBIM models by making up graphic products for analyses and accurate tridimensional documentation of Casa de Vidro's set of buildings.

The chapter is organized so as to present: the procedures for collecting contextual, spatial and photographic data; 3D point cloud processing and photogrammetric procedures and results that supported the development of the Casa de Vidro's *Historical Building Information Modelling* (HBIM), which is described in the next chapter.

Accurate documentation and tridimensional recording process of historical buildings come in an opportune time when Information and Communication Technologies (ICT) have greatly benefitted projecting, building and management processes, although such technologies are still seldom used for conservation works with historical buildings (Dezen-Kempter et al. 2015).

In regard to existing buildings, a key step is to assess their physical-geometrical features in order to generate documentation consistent with the actual scenario. As for high historical-artistic importance buildings, which should therefore be preserved, information accuracy and consistency are requisite for analyzing their current status, operation and maintenance requirements and supporting intervention studies. As a result, this work combines practices adopted for developing the Casa de Vidro Conservation Management Plan (CMP) with reference to digital technologies used for documenting and virtually reconstituting in the heritage building in question.

Accurate documentation is an essential factor in successful cultural heritage conservation, for it allows for the understanding of the heritage resource's significance, conditions and complexity (EPPICH; CHABBI, 2007). Letellier, Schmid and Lebanc (2007) highlight that documentation and information management should not be limited to the duration of the conservation project, but must rather be a constant activity.

According to Eppich e Chabbi (2007), in a conservation planning process, documentation provides the long-term baseline for monitoring, maintaining and managing resources, ensuring this knowledge may be passed on to future generations. Endorsing this view, Schmid and Lebanc (2007) suggest that documenting a heritage building can assure building memory perpetuation, even in case this heritage resource evanishes due to natural disasters, negligence or inadequate conservation.

Eppich and Chabbi (2007) consider that cultural heritage documentation has become more complex, requiring now more resources for proper recording. This process consists of multidisciplinary assignments that comprise information provided by professionals and nonprofessionals from various fields (LETELLIER; SCHMID; LEBLANC, 2007). According to Rodríguez-Moreno et al. (2018), if the records produced in this process are classified and kept in a documentation archive where building components are treated as detached objects, unrelated to its environment, information will be fragmented, which affects the global assessment of the resource subject to conservation.

Different tridimensional assessment techniques have been used to document historical buildings with geometrical precision. Among them, we can highlight those derived from photographic assessments, photogrammetric processing and techniques related to 3D laser scanning.

According to Fritsch (1999), **photogrammetry** is a photo image scanning and processing technology for determining shapes, position and geometrical features in order to generate tridimensional virtual models. As a science of remote sensing and measuring the geodesy field, photogrammetry has its own techniques for obtaining geometrical data out of objects represented in photographs (Linder, 2009).

Such techniques allow for 2D photographs – with different perspectives of the same object –, when combined, to determine spatial coordinates and correct perspective and focal distortions, producing as a result orthogonal mosaics of images. Therefore, they enable the production of information for documenting heritage resources (Fritsch & Klein, 2018).

According to Groetelaars (2015), the use of manifold digital photogrammetric techniques makes it possible to obtain a significant amount of geometry data, measurements, designs, orthophotos, among other information. In addition, the use of photogrammetry measurement methods has increased, when compared with traditional methods, due to its speed and easiness for obtaining results (Barbasiewicz, Widerski, & Daliga, 2018).

Analytically, photogrammetry operates on a basis of centimetric accuracy, resolution of thousands of points, 3D manual modelling with post-processing and is relatively more affordable (Dezen-Kempter et al., 2015)fotogrametria. Moreover, using photos for measuring means being discharged from physical contact with objects, which facilitates jobs with difficult accessibility, and helps conservation and preservation of resources intended to be preserved, as highlighted by Linder (2009).

3D scanning allows obtaining geometric models from a point cloud set up through laser beam scanning (GROETELAARS, 2015). Fritsch and Klein (2018) show that combining photogrammetry and laser scanning can generate tridimensional models that are geometrically accurate and quality textured.

Along with photogrammetry, laser scanning is one the most used technologies for assessing buildings. It has millimetric precision, resolution of millions of points and automatic shape capture and extraction (Dezen-Kempter et al., 2015) fotogrametria.

In regard to Casa de Vidro, designed by Lina Bo Bardi, extensive tridimensional documentation has been produced through photogrammetric, 3D laser scanning and HBIM modelling techniques, which was altogether the result of a collective work focused on the building Management and Conservation; a job that lasted around two years.

The Brazilian team worked in collaboration with Italian researchers from the Ferrara University during the phase of 3D laser scanning the buildings and gardens (see next text 5.5 **Documenting Modern Architecture to Learn from Masters**). The Italian team has also provided training to the Brazilian team on manipulating the resulting point cloud.

The research was exploratory in nature and evolved from a case study on the use of Terrestrial Laser Scanning (TLS) technologies, HBIM and photogrammetric techniques as documentation basis for Casa de Vidro, for purposes of historical heritage management, building memory conservation, structural, construction and pathological records, and support for future interventions and use management of this heritage resource.

One of the issues that stimulated the research is linked to the limitation of traditional documentation methods for combining and managing information concerning the building. Intending to use BIM for assisting in the heritage management of Casa de Vidro, we tried to develop a HBIM model and, subsequently, integrate it to the building damage mapping. This data, obtained through the use of a tool designed for integrating BIM-model into the damage mapping, was qualitatively analyzed.

Following accurate tridimensional assessment, the subsequent step was to record and consolidate information in semantically enriched databases for documenting and analyzing physical and cultural features of the heritage resource in question. It is also important that information is recorded in formats that allow project manipulation to simulate repairs and interventions to the building.

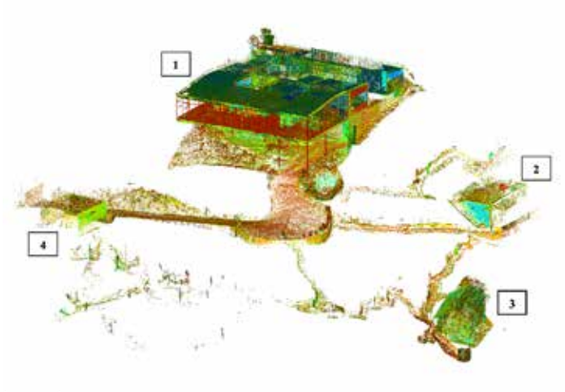


Image 1.
3D point cloud of Casa de Vidro's set of buildings and pathways. Clockwise from the image center: Casa de Vidro (1), Housekeeper's apartment (2); Studio (3); Garage (4).

Post-processing and interpreting the point cloud of Casa de Vidro

The architectural and landscape set under analysis consists of the Casa de VIdro itself, where Lina and Pietro M. Bardi lived, Lina Bo's studio, the housekeeper's apartment and the garage. The buildings are interconnected by a series of pathways that cross a stretch of woodland and gardens.

From the point cloud that was prepared and processed, as presented in the next text 5.5 **Documenting Modern Architecture to Learn from Masters**, the data was handled by the IAU-USP team. This work focused on preparing internal and external high-quality building sections for the visual understanding of the spaces and the elements of the buildings, as graphic products were prepared in scale, such as plants, cuts, elevations and building perspective views.

The analyses performed began with segmentation, noise cleaning, and point cloud organization so that the graphic products and the cloud itself could be formatted in order to be integrated into documentation and building information modelling softwares. In this process, layers were created for comprising each building, access way, garden pathway and others, as required, so as to tell apart and manipulate the points of interests from other scanned elements.

Laser scanning is capable of producing an expressive amount of geometric data and, in this case, 8 billion points were generated, each of which with XYZ coordinates and RGB color parameters. In virtue of the technology employed, the colors atributed to the points relate to the laser reflection conditions and not to each material's colors themselves, in such a way that every point is represented by a "false color" (see images 1, 2 and 3)

Due to the large amount of data and to the nature of the point cloud visualization, the geometry interpretation and the elaboration of products based themselves on segmenting the cloud by means of selecting and categorizing elements of interest in specific layers, so that isolated views were rendered possible. Besides, cloud segments could be recolored in better contrast and, in specific anlyses, their colors were atributed according to their elevation quote.

Once the cloud was processed and segmented, it was possible to extract a series of images with a very accurate dimensional precision, depicting geometrically the set of buildings and enabling the analysis of geometric aspects regarding the construction and current conditions of the building. In these processes, mesh structures were used, which had their spacing determined according to the appropriated scale and precision, and set up according to the analysis plans.

On the following pages, we present different images that allow us to characterize Casa de Vidro in detail. In image 2, we have a perspective view of the Casa de Vidro. Images 3, 4 and 5 were produced with varying degrees of segmentation width of the cloud, by activating different layers for rendering images. In image 3, we work with a transversal cut of small width, emulating a transversal cut in Casa de Vidro. Images 4 and 5 are 3D cuts, with vegetation layer at first displayed and then concealed, emulating a transversal cut, a 3D transversal cut of Casa de Vidro and a 3D transversal cut in the midst of the garden.

Images 6 and 7 emulate cuts of the floor plan of the building. In image 7, the ground and first floor plans are overlapped (in detail) on the the area, allowing the identification of a minor eccentricity between the sections of same column at the ground floor and the first floor segments.

Image 8 highlights the main access stairs to Casa de Vidro, in which we can observe small deformations on the structure of the stairs.

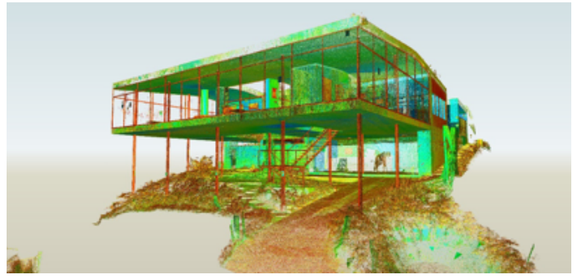


Image 2.
Isolated view of Casa de Vidro: main building, 2017.

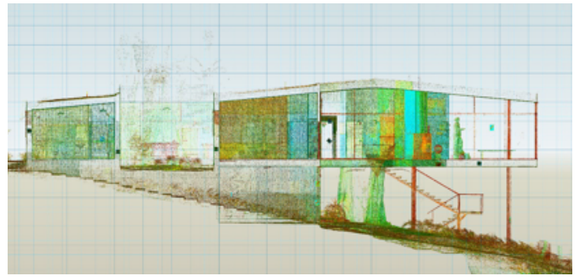


Image 3.
Transversal cut of the main building.

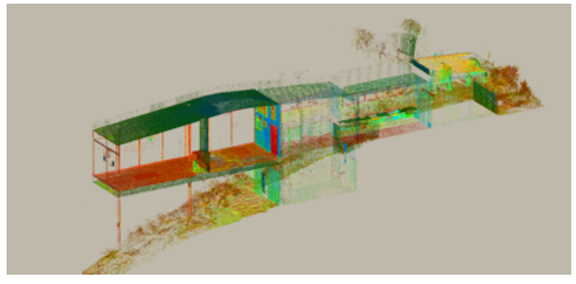


Image 4.
3D transversal cut.

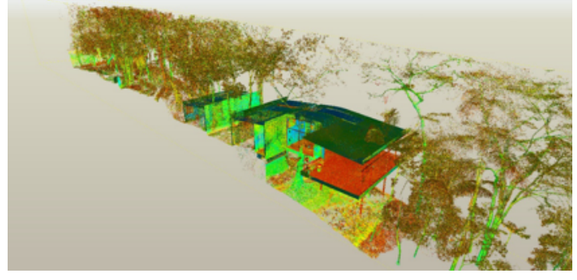


Image 5.
3D Transversal cut of Casa de Vidro amidst the vegetation.

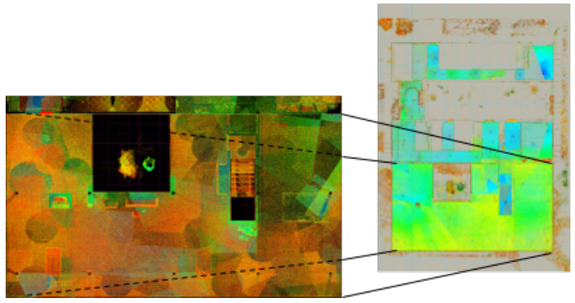


Image 6.
Floor-plan of the main building rendered out of 3D scanning and detail of the floor of the living room

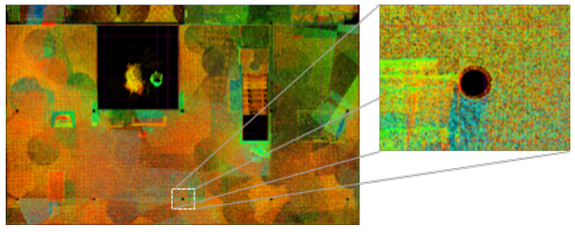


Image 7.
Floor-plan and detail with the beam eccentricity, compared to section on the ground and first floors.

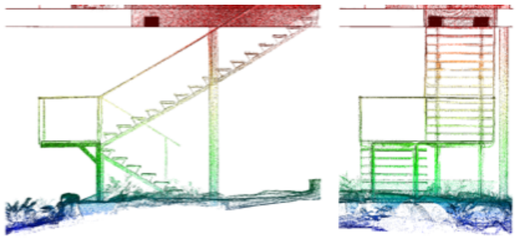


Image 8.
Image of Casa de Vidro's main access stairs.

With this same segmentation process, terrain topography was analysed through the scanned point cloud. Every tree crown was isolated in separate layers so that the points associated to the terrain could be visualized. Such points were colored according to their elevation quota in a scale ranging from cool color tones (for lower quotas) to warm color tones (for higher quotas), varying it at each meter.

This way, an elevation map was then generated, which was used during the studies for the interventions to Casa de Vidro's gardens. Images 9 to 12 portray the segmentation and processessing, displaying results stemming from this work.

Cloud segmentation was also necessary to make its integration to HBIM models possible. In virtue of the large volume of points captured — around 8 billion — segmented files of the point cloud were created for each building, linked nonetheless to register database. BIM modelling files were also individually developed for each building, sometimes linked to the corresponding segmented files of the point cloud. Thus it was possible to manipulate the point cloud according to the available computational capabilities, optmizing integration of BIM models into the cloud.

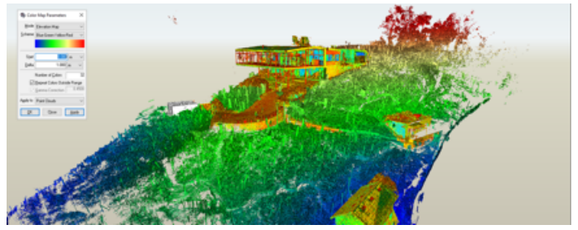


Image 9.
Elevation map from the point cloud – Stage 1.

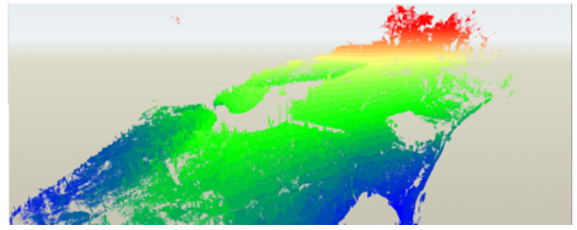


Image 10.
Elevation map from the point cloud – Stage 2.

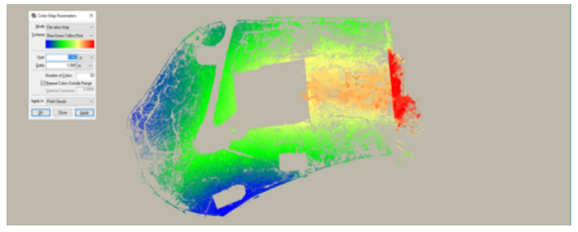


Image 11.
Elevation map from the point cloud – Stage 3.

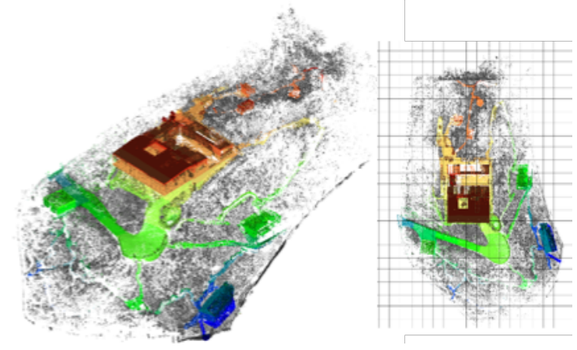


Image 12.
Segmentation process of the point cloud for the implementation study of buildings and connection paths.

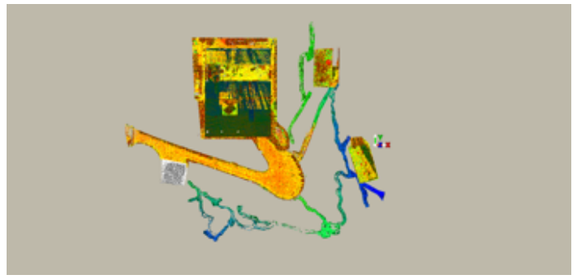


Image 13.
Elevation map from the point cloud – Stage 4 – Paths Study.

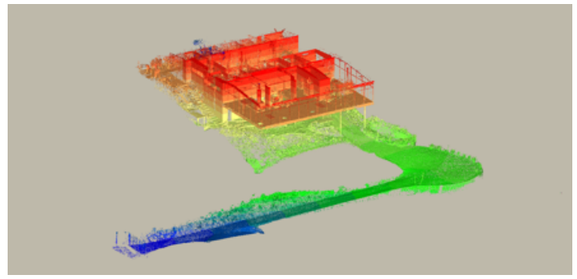
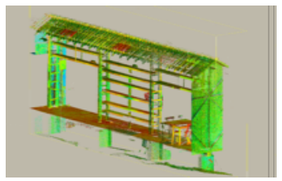


Image 14.
Elevation Map with color gradient and main access path.



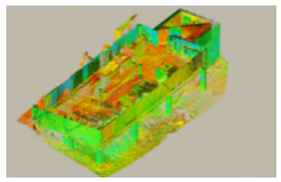


Image 15.
Isometric Perspectives: (a) floor-plan and; (b) internal shelves of the Studio

As an ilustration of this process, we will take the initiative devoted to modelling the *Studio*. In this study, the point cloud was organized in layers with *Leica Cyclone*, by means of categorizing the points so that the construction elements could be isolated from unrelated elements, such as trees and other external elements. Graphic products, illustrated in image 15, were extracted from the segmented point cloud.

For the next step, the cloud was emulated in *Autodesk Revit* (see image 16) using *Leica CloudWorx* plug-in for controlling the point cloud density and appearance and thus proceeding to modelling. *CloudWorx* funcionatilities were used primarily to optimize the use of computational resources during the modelling process, iteratively adjusting the parameters of emulation, for instance: augmenting visualization definition (quantity of points) if needed and, if not, diminishing it in roder to reduce processing demand.

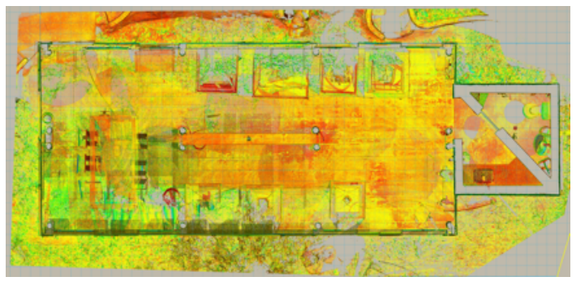


Image 16.
Point cloud of the Studio's emulated floor-plan.

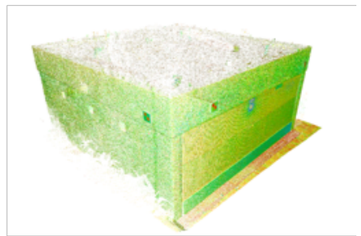


Image 17.
Garage's point cloud.

Photographic survey

Photographic survey aimed the creation of a collection for subsidizing the application of photogrammetry techniques. The shots intended to capture the whole set of buildings, producing an archive of 901 images categorized as follows:

Site	Amount of photos
Main building (interior + surroundings)	709
Small house	37
Housekeeper's appartment	19
Garage	33
Others	103

Table 1
Photograph shots count

For this survey, it was used a D300 Nikon camera with lens of 12.00 mm (nominal value), calibrated and set with fixed focal distance[3]. A DJI Mvic-Pro drone was also used, which can travel at about 13 km away from the controller, with approximately 20 minutes of flight time per battery charge, equipped with a 12.35 megapixels integrated digital camera and a three-axis mechanic stabilizer. The shootings were manually controlled and some of the selected images are presented below (images 18-20).

Image 18.
Rain gutters and channel flashing on the edges of Casa de Vidro's

roof: main building.
int cloud.

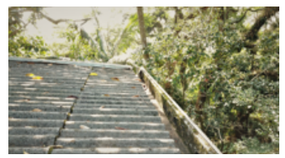


Image 19.
Aerial view of the Garage's roof.

Image 20.
Aerial view of the main house's roof and its contrast with vegetation

photogrammetry of the *Studio*

For the *Studio*, we also used techniques of photogrammetry restitution through image processing software *Photomodeler 2018*. This processing was performed individually for each of the building's faces, in such a way that the results for the North and East faces were obtained individually. The survey covered the East face (lateral), the North face (principal), and partially the South face, as well as the roof and the brickwork of the West part. 37 photos were shot, with minimal overlapping of 50% on Mai 28th 2018, during a technical visit to the.

In each shooting session, the objects of interest were carefully focused, attempting to avoid intense shadowing and excessive light incidence. The images were analyzed in a laboratory and then selected, while the ones presenting focus and lighting problems were discarded.

Image 21.
Examples from the set of selected images of the East and North faces

The selected images were then used in the photogrammetric reconstitution of the building, performed with *Photomodeler UAS 2018* software. The procedure included the identification and manual creation of homologous points in each image, i.e. points representing one element that appears in many photos. Next, these points were related to one another so that the images could be spatially oriented, distortions could be corrected and an orthogonal photographic mosaic could be generated, which here is denominated orthomosaics.

In the following step, it was adopted points relative to the vertical and horizontal axes of the building face in order to correct the horizontal and vertical alignments of the products. Finally, the scale of the resulting orthomosaics was adjusted by means of an assessment of the measurements of the 3D scanned point cloud, using *Leica Cyclone 9.1* software.

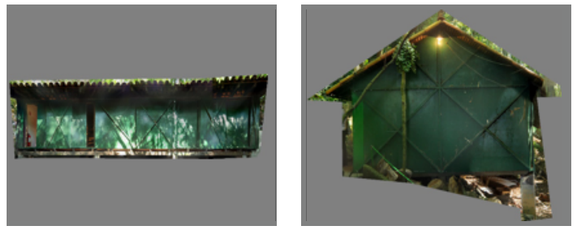


Image 22.
Studio's orthomosaics. (i) North face; (ii) East face. Source: Image rendered by Júlio Jr. (Aquitec-IAU/USP's Researcher). Software: PhotoModeler

In image 13 the resulting orthomosaics are presented.

Lastly, these orthomosaics were incorporated into the BIM modelling of the building, along with their corresponding point cloud. BIM modelling was developed within the *Autodesk 2017* software, where the point clouds as well were emulated via *Leica CloudWorx* plug-in.

In images 23 and 24, it's presented the incorporation of the orthomosaics into the BIM model views, along with the integration with the 3D scanned point cloud.

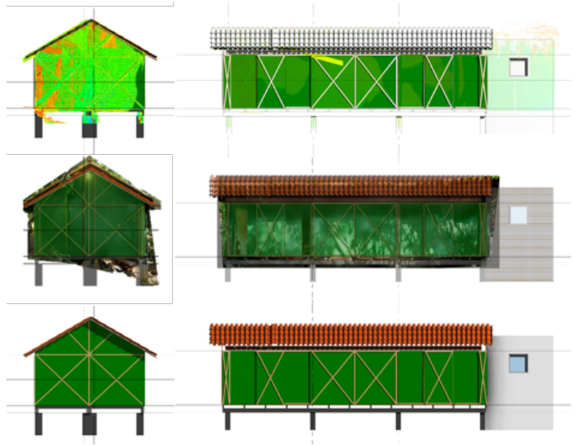


Image 23.
From top to bottom, (i) Point cloud + HBIM; (ii) BIM (semitransparent) + Orthomosaic; e (iii) resulting HBIM Model. Source: Image rendered by Júlio Franco

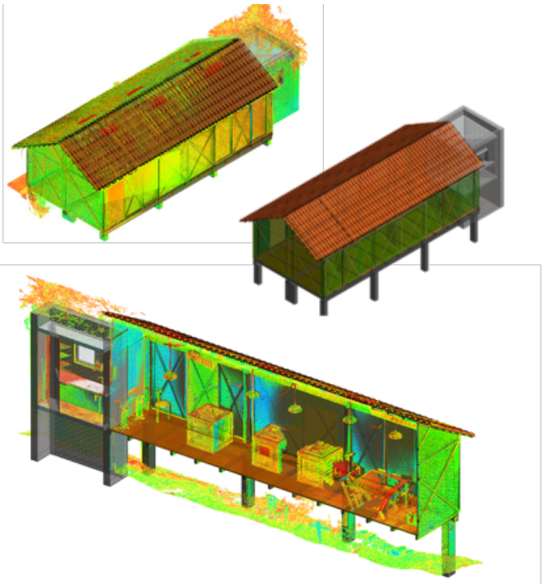


Image 23.
From top to bottom, perspectives are composed through: (i) Point Cloud + HBIM; (ii) resulting BIM Model; e (iii) Point of Clouds Cut + BIM. Source: Image rendered by Júlio Franco.

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Notes

1 Brazilian team for the digital documentation goal consisted of Prof. Márcio Minto Fabricio (documentation goal coordinator), architect and Dr. Ana R. M. Cuperschmid, civil engineer and MSc candidate Júlio César Franco Jr., architect Welen Martins and trainee Marina Grachet. Besides manipulating, generating and interpreting point cloud information, the team worked on the building's HBIM modelling, integration of BIM 3D model into point cloud, integration into the BIM structural model developed with TQS by an specialized consultant and recording 3D model pathologies.

2 The images that appear in this text were rendered by Júlio C. Franco Jr., with Leica Cyclone Software based on the point cloud captured by the 3D scanning (Leica Scanner) performed by the University of Ferrara team, Diaprem, São Paulo, 2017. Task 2. Coordination: Márcio M. Fabricio.

3 This assessment was supported by Professor Dr. Arivaldo Leão Amorim, from the Federal University of Bahia (UFBA), who directly helped in the shootings and in the training of the IAU-USP team on photogrammetry.

5.5 Documenting modern architecture to learn from the masters

The integrated survey of *Casa de Vidro* by DIAPReM Center, University of Ferrara, Italy. Marcello Balzani, Federica Maietti and Luca Rossato

Abstract

Recent BIM modelling procedures and 3D integrated surveys have greatly improved the overall knowledge on some Brazilian modernist buildings. In this framework, the *Casa de Vidro* 3D survey carried out by DIAPReM Centre at Ferrara University (Italy), along with the important outputs extracted from the database, was also useful to test, in cooperation with local stakeholders, several activities meant to increase awareness. In order to face the challenge of preserving modernist buildings, government agencies and professionals should be able to pick the most suitable tools to the tasks of documenting, monitoring and carrying out the yearly maintenance of such buildings.

Keyword:
3D survey, documentation, modernist heritage

Introduction

Documenting to transmit meaning

Working with cultural heritage comes down to transmitting a meaning or a cultural, technological or construction process to someone who might be (since they come after us) hostilely passive or potentially indifferent to it. In the building process and in architecture, the passage is not just that of a ritual or of a memory but is also constructive, materially identifiable, connected to the desire to make an immobilized cultural value inheritable: it belongs to a complex category of social and cultural language.

When the conflict with the pre-existent is latent or denied, a resolution then opens it up to the project, a few "traditions" are preserved to the point of cliché repetition: in this regard, Émile Durkheim created the category "chronic anomie" to define this issue (DURKHEIM, 2001).

The passage needs a translation to avoid being traitorous or at least to be so as little as possible, since traditions often take on an intolerable meaning as if they were being uttered in an alien language. The translator/traitor, therefore, is not doing something negative, but rather highlighting the problematic nature of the passage and, in a certain way, triggering it. The effort is that of transmitting meanings, even if they will be distorted (or falsified) when compared to its original sense, which is triggered by the need for change, development and transformation (the restoration projects for example).

The problem regarding the forms that define places or buildings – including the modernist ones – seems often linked to the capacity to describe and "revoke them". Knowing how things are made is not easy. From a certain perspective, it concerns the shared experience, the possession of uniting, of formally taking part into; nonetheless, describing and representing all this is something different. If human experience becomes qualitative, gaining emotional meaning, as stated by Merleau-Ponty (2008), then the relation with the other qualities (which often have nothing in common with it) starts to become understandable. In fact, the problem is tied to a delta, or a variable, within which a trace of reality can be inserted, the problem of spatial description and its translation. If life is lived as if in Plato's cave, where we can only perceive the shadows (projections) of the reality that unfolds outside, then the design act (artistic, architectural) can make things vibrate and legible, even if just for a moment in which folds and cracks seem to energetically convey the vital, organic, biological activity of existence. As Bergson wrote in "Matter and Memory" (BERGSON, 2007), this relation is never frontal, but rather "oblique and clandestine", and it is precisely in the capacity to make it stand out and express something that we can understand how it is often things that shape our attempt to endure. Time is, after all, hesitation; and if memory is a weak attempt at defense, material (that which is sacrificed in the arduous ritual of conservation, reconstruction or, most of the time, negation of the interpretive process) can be a concrete intuition of duration in the translation of the survey and the project. Moreover, it would be on the one hand anachronistic in the liquid age of immersive consumerism to not also see in this meta-representative action a damp irony that pervades materials as if it were impregnated by a controlled atmosphere. Fluidity, which apparently helps to consolidate numerous temporal similarities, obviously brings into being the double ambivalence of time: on the one hand measurable (with more or less sophisticated scans of nature and instrumental artifice) and, on the other, perceptible in a dimension that is at once chrono-biological (circadian, infradian, ultradian rhythms) and emotional/intimate/psychological.

The temporal direction and contemporary technologies

Experience teaches us that there are natural processes that are irreversible, what is the same as saying that the world around us (us included) ages and changes day by day with no hope of going back. This is a reality architects are well familiar with, perhaps from the very first moment when, still as students, they step across the threshold of a school of architecture and come up against the exams of the initial two-year programme, where, through surveys and drawings, they are obliged to try to understand first what space is, then what forms in space are, and lastly to come to grips with how they are, and how they live, by translating into materials what their reason of life is. In everyday life it is practically impossible, when one is carried along by daily experiences, to rid ourselves of the idea (which some believe is an integral part of our biological makeup as determined by the evolutionary process) that all-natural phenomena are part of a unidirectional flow (going from the past to the present and on to the future). Somehow, we might say that our brains memorize actions and phenomena according to an invariable framework that fixes the past as having been, and thus unalterable, and the future as completely indeterminate. This is a very basic concept deriving from experience, on which history and many other descriptions of the expressions of humanity are based. It is a concept that possesses the power of a cogent law, deeply rooted in physiological, psychological and social-historical arguments of no small import and wealth in what regards content. However, in the realm of elementary phenomena, every physical process may take place in the forward direction, from the past into the future, or else in the opposite direction in time, from the future toward the past. As a consequence, there is no favored direction for the flow of time in elementary physical processes because both directions –the natural one, that accords with our empirical experience, and the opposite one – are perfectly equivalent for the purposes of describing phenomena. In order to express the value of an asset, one attempts to identify and valorize its uniqueness and thus to make reversible every operation which was worked upon it, in the sense of being as little contaminating, destructive, interpretative, and dispersive as possible, to allow those who come later to be able to enjoy the same asset and be able to take further reversible action with constructive and conservational technologies that are even less invasive and more preservation-focused (KOLLER, FRISCHER AND HUMPHREYS, 2009).

The major surveying technological tools (3D laser scanners mostly integrated on total stations and digital cameras) are continually updated with regard to speed of acquisition, accuracy of data in relation to the relevant operating range, portability and lightness of use, interface flexibility. The degree of innovation that the industry offers to the professional market is not always supported by a level of information and technical knowledge capable of absorbing the real potential of use.

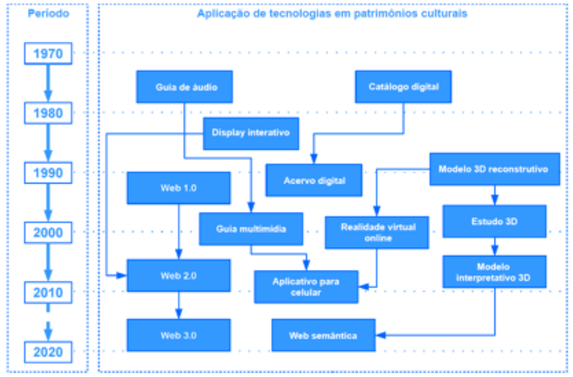

Fig. 01:
development of technologies applied to Cultural Heritage

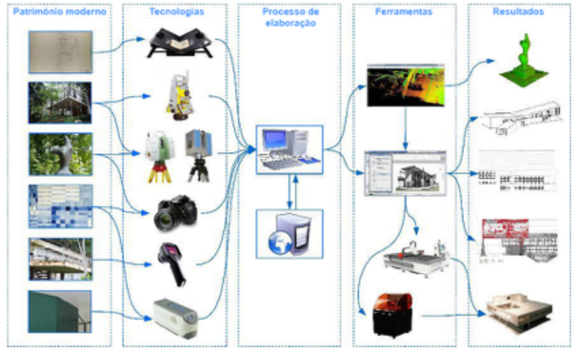

Fig. 02:
the integrated methodology on Brazilian Modern Heritage developed by DIAPReM Center

For this reason DIAPReM (Development of Integrated Automatic Procedures for Restoration of Monument), a research center at the Architecture Department of Ferrara University has, for over fifteen years, tried to develop optimized procedures and applications that make more accessible and cost-effective the technology transfers from the productive sector to the construction network (professional engineers, service companies, ministries, local authorities, construction and restoration companies) (BALZANI, MAIETTI, 2008). Since 1997, DIAPReM has been developing operative procedures for the 3D geometric modeling and virtual representation of architectural complexes of a monumental nature as an analytic tool to aid in a comprehensive interdisciplinary approach to the study of such complexes.

The research center is especially engaged in sectors relating to the preservation and restoration of archaeological sites and architectural works. Its specialties include 3D surveys, solid prototyping of architectural features and antiquities, multi-spectral analysis, the study of historical material and of the technical and structural problems associated with artefacts of historical interest, and field work and analyses for architectural and archaeological heritage site restoration and preservation projects in relation to the environment and the territory. The center has been involved in Italy and abroad in many research activities and it has helped in developing preventive preservation strategies employing innovative methods and technologies for heritage site monitoring and controlling and for urban and environmental upgrading.

Nowadays, working between innovation and documentation strategies, the problems come up in the logic of creation, management and use of real 3D data. The descriptive process is, in fact, strongly linked to the traditional two-dimensional drawing, even when it tries to emulate the results represented in the spatial complexity. This procedure is historically connected to the simplicity of such models: the discreet and simple elements of a two-dimensional representation offer a series of limited configurations that are easily understood and used. However, some of the problems that arise from it must be pointed out:

- the majority of technicians working on the digital drawing (even if in 2D) forgets that this is a spatial operation – those who do not understand, in a critical and careful way, that every sign of change, integration and correction of a project will also change something on some other part of the project, and that this demands verification (prospects, sections, plans). Here it is possible to correctly get the limits of the procedure in the work site at (in front of the real three-dimensional space);
- until today, the degrees of variation, the “distance from reality”, are offset by criteria of gradual approximation that can also be contained in the economic estimate evaluation. In other words, the compensation of the technological error observed is made possible throught a value to manage the basic shape error. The economic damage is significant. It Alternates between configuration discrepancy and a morphological inaccuracy, which, for the more complex realities (often associated with restoration or recovery) can be up to 20-30%;

- the attention given to what there is (whether what is subject to restoration is something antique, even of lesser value, or something fresher, to operate upon with reuse, regeneration, functionalization and recoveries) necessarily produces the need to control the subject to transformation with greater security. Such reasoning is not trivial, since for the last thirty years the expansion model of city suburbs has contemplated project logics that little relies on construction reality. The habit to design in relation (of knowledge and critical consciousness) with the context is not so widespread as one would imagine even if the technical instrumentation and conception are very different. The project that is born on a virgin area of an allotment possesses, in its genetic code, relationships of form and proportion that relate to independent architectural thinking and is often self-referential. The project created within or next to pre-existent projects is a one that has to adapt to sensitivity of shape, size, materials that have layered over years and have already undergone comparison with the construction process and time. The tolerances (not only geometric, but also conceptual) to be taken into account are completely different.

The idea born within DIAPReM Center was originally very simple and tried to offer an answer to this issue: if a new technology comes up in the market, it should, first of all, be able to do (possibly better) what has already been done. The improvement can be identified in the time (faster) and accuracy factors (generating measurements that are more secure in the representation and querying phase of data). If it happens, then it is possible to lead the technical operators towards a second stage: make them understand how operating preventively inside an architectural structure, according to rules of measurement and geometry (in a 3D morphometric environment on 1:1 scale) can lead to cost-effective solutions (that can be shown in analysis and visualizations) for those who work in such sector and for society itself. It is therefore understandable that, in order to act upon this issue, it is not only necessary to focus on the optimization of the complex phases of survey, but it is also crucial to:

- understand all the phases of the process, from survey to planning;
- listen to and embrace all doubts of the draftsmen and institutional commissions;
- spend lots of time and effort on the process analysis.

The introduction of instruments (with their potential only apparently intelligent) has made room for the idea that the processes of awareness and understanding are not needed, or at best are less required, when what happens is exactly the opposite. These technologies (from automatic design to laser scanner survey) – objectively powerful for enhancing speed, accuracy, capacity of displaying – trigger the need to further develop a new critical-conceptual instrument (CENTOFANTI, BRUSAPORCI, CERASOLI, 2014). An effort of awareness that restoration already possesses in its DNA and is ready to reinforce.

Knowledge technology and development strategies

The economic crisis requires operating with a different kind of attention from that of the past. The subject of managing the cultural heritage (be it a specific site or within a museum) is at the heart of the debate. Many projects that are being developed often regard the reunion of these two fundamental objectives. The experimentation is thus not exclusively connected to the restoration process, but also to fitting out technologies, the territorial marketing strategy, and the management model; technologies that need to be planned in synergy, together from the first moment. A multidisciplinary and cooperative approach is nowadays needed in order to face many challenges linked to cultural heritage documentation and preservation (BIANCHINI 2014).

For instance, the 3D surveying technology, carried out for the diagnosis and planning of a restoration project can generate a marketing and communication product for the exhibition, while the opposite is not possible. It always happens that technologies are first invented, produced and developed, before it is realized what they can do, not from the factual and final point of view but from a perspective of method. The critical approach is, instead, part of a real acquisition of knowledge that discriminates, selects, verifies and produces differences. The world of restoration is the place where these conflicts have been mostly expressed and therefore more solutions can be found. A project on historic heritage requires a conscious flexibility and a smart vision expressed by deep knowledge of the building also in terms of digital data. These data should be used as a baseline for students and academics (not only in Brazil) for further analyses on both built and unbuilt architectures or more specific research on modern architecture even from afar. In this process of knowledge and toward a real scheduled maintenance programme the 3D integrated surveys have great importance. The cooperation with the scanners manufacturers in Brazil has shown how it could be possible to use expensive tools even in medium-budget projects. This could help to improve the spread of new technologies in the heritage field in Brazil and the creation of a net of laboratories able to autonomously develop local methodologies for the preservation of modernist buildings.

Fig. 03:
some 3D integrated surveys performed by DIAPReM in Brazil since 2004

Creating accessible databases and digital archives
The cultural heritage can be represented using the most suitable technologies. In regard to architecture, techniques such as 3D modeling, virtual reality, animation, or digital video may be employed.

All these apparatuses are not mere gadgets, but actual digital tools that facilitate the understanding and studying of both built and unbuilt projects, offering opportunities of analysis in an immediate way. That's why the real key to a revolution in this field is certainly the use of telematic networks for sharing knowledge.

In fact, these tools provide access to a wider cultural heritage. And thanks to search engines specially designed for this goal, the access to big databases is granted, not only for traditional searches, but also for other sorts of information, such as images, templates, themes, etc.

All this will offer the student the opportunity to develop surveys taking on large databases on the net, making it possible, for example, to visualize all the buildings by a specific architect. The professionals, researchers and students can access information about the works, wherever it is stored, and then compare all similar works. In contrast to this potential, it is important to highlight today, and even more in regard to the near future, that such abundance of data on the network generates pathological effects, including uncontrolled proliferation of references and lack of validity and reliability of the information transmitted. The set of data – paper documents, drawings, photos – is a source which, if not properly structured, and cleaned up in order to remove redundant information, could appear to be out of control both in terms of accessibility and verification of the information accuracy.

Nowadays there is a repeatable model that allows a procedure to be carried out step by step, from conception and composition up to the finalization of the data, through a methodology for data cataloguing. Understanding the architectural project and being able to reproduce it with digital technologies will also improve the conservation of the design process. The preservation of the architectural projects designed by the masters is nowadays becoming a crucial point. Very often cultural foundations that manage the archives of the great architects of the 20th century are not always able to ensure an effective conservation because of the lack of funds.

Redrawing the modernist architectural projects also means preserving the lessons learnt in terms of architectural and spatial composition (GAIANI, 2013). The information system, consisting of sketches, drawings, images, maps, needs thus to be understood and represented with all its features, a set of elements linked by hierarchical relations in a sort of conceptualization of reality. The young students and researchers can play a key role in this process, as stressed by A.M. Ronchi when talking about digital literacy: "there is a need to channel the creative energies of young people by promoting digital literacy in the field on new ICT-enable or empowered creativity and expression" (see Fig. 04).

"There is also a need to create a proactive environment that enhances the overall quality of eContent products. Digital and social divides must be bridged in order to provide access and added value to citizens. Digital technologies and ICT tools provide an incredible opportunity to encourage growth and prosperity. Digital content and services empowered by broadband communications, both wired and wireless, could have a significant impact on society. One of the first steps in this direction is to promote human networking and the exchange of experiences and skills amongst different groups and communities" (RONCHI, 2008, p. 14). For instance, the collection of 3D data in cultural heritage preservation sites is useful for a wide variety of applications and it could also be integrated with other technologies to improve the overall knowledge about the object. But it also means to have the right skill to interpret and analyze the big amount of data, as the data captured by laser scanners on a field campaign has to be elaborated in order to create a useful 3D database. Only with the right methodology these data can be properly used to extract geometric information related to the building (such as plans, sections, etc.) on different scales, depending on the required level of detail. As stated, 3D laser scanner outputs (point cloud) could also be integrated with other sources of information, such as high definition photographs, thermal images or spectrophotometer data (color analyses).

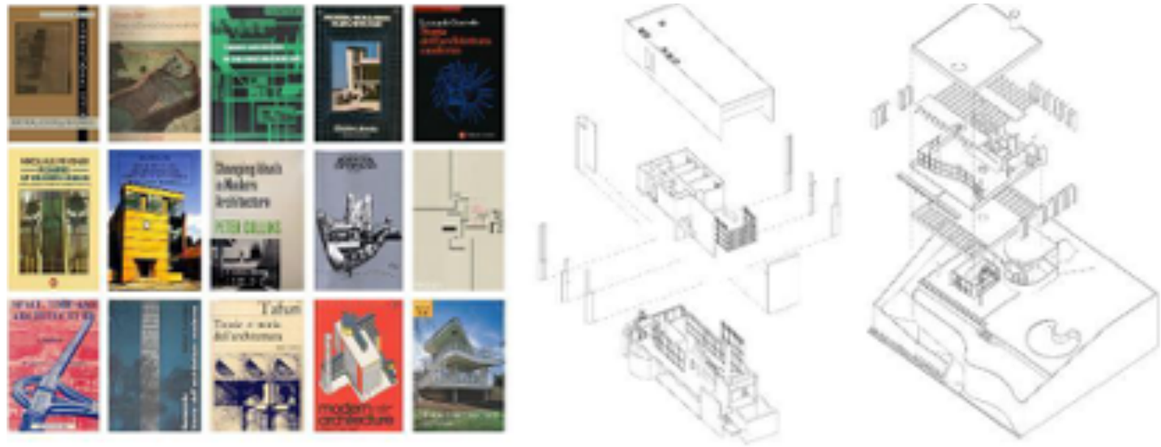

Fig. 04:
3D elaborations developed by students of Ferrara University Architecture Department: from the investigation of the available sources to the creation of BIM models (since 2014)

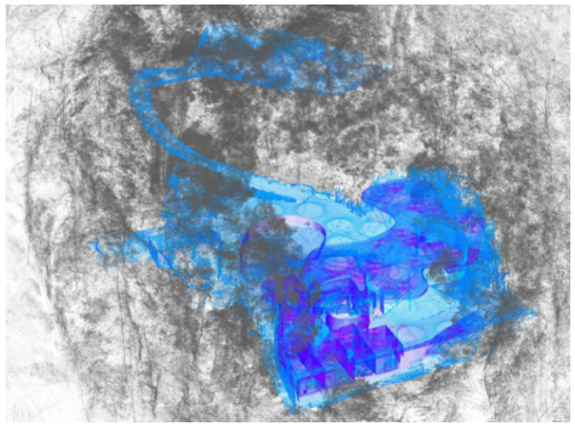

Fig. 05: general point cloud of Casa das Canoas (2014 research project), a tropical house built in a stunning natural environment

Modern tropical houses: a cultural heritage in danger?
In November 2014 the DIAPReM Center of the Architecture Department of Ferrara University performed the integrated 3D survey of Casa das Canoas, in Rio de Janeiro. The research was carried out aiming the documentation, the knowledge and the preservation of one of the most important architecture work designed by Oscar Niemeyer.

The research project was conceived in cooperation with the Oscar Niemeryer Foundation in 2013, in order to find a methodology for documentation aimed at defining conservation procedures for the buildings designed by the great Brazilian architect. His ideologies in terms of society, politics and architecture, as well as his style, are fully expressed in the architecture of the house in Canoas, which was a remarkable achievement of modernist architecture (WARCHAVCHIK, 2006). The survey allowed the Italian staff to get familiar with tropical architecture context in a learning-by-doing process that was crucial to develop the right methodology for the survey of Lina Bo Bardi house two years later. Furthermore, the 3D laser scanner survey of Casa das Canoas is consistent with the digitalization of the Oscar Niemeyer Foundation archive, as one of the Foundation's priority is to create an archive of Niemeyer's drawings for researchers and academics.

In order to accomplish the research projects, four main actions were carried out: a detailed architectural analysis, the study of the relationship between architecture and sculpture, the relationship of architecture with the surrounding green landscape and the diagnostic survey (to document the materials' state of conservation).

The relationship between the project design and the actual construction, the inclusion and integration of the architecture in the natural landscape (BOTEY, 1996) and the material conservation' issues in this particular natural context once again led to a choice of survey technologies able to meet the problems of memory preservation. Therefore, the 3D laser scanner survey was aimed at knowledge, documentation, protection and enhancement of this important cultural heritage and the surrounding landscape. The digital survey campaign, including the external areas and the garden, has been integrated by a diagnostic survey in order to map the state of conservation and the main issues concerning degradation.

The work has been selected to be part of the CyArk 500 Challenge, a CyArk's ambitious goal to digitally preserve 500 cultural heritage sites until 2021. The Foundation and its partners are on a mission to digitally preserve these cultural heritage sites before more of them are ravaged by war, terrorism, arson, urban sprawl, climate change, earthquakes, floods, lack of maintenance and other threats.

The Casa das Canoas project was selected because of three factors: level of risk faced by the site due to natural and human-induced threats, significance of the site in its local,

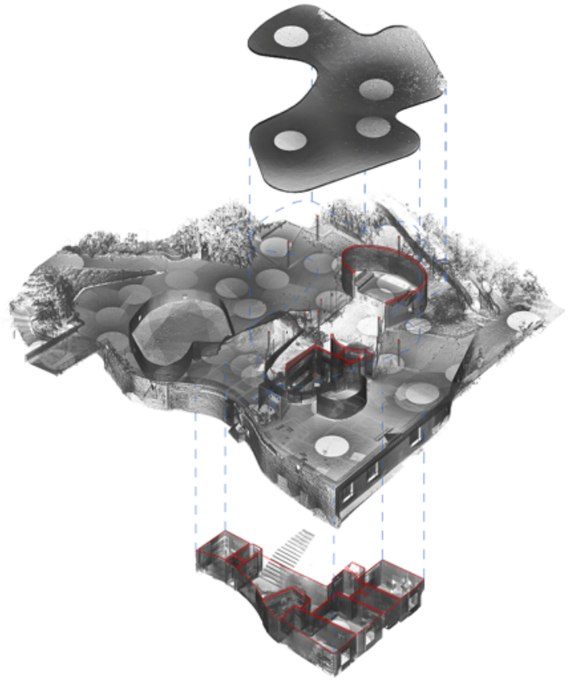

Fig. 06:
tridimensional study by point cloud elaboration of Casa das Canoas reveals the complexity of Niemeyer design

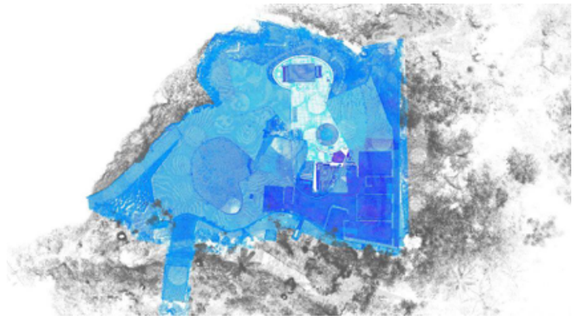

Fig. 07:
Plan view by 3D point cloud. For the first time the 2 levels of the house were overlapped with high accuracy

national, and international context, and benefits of incorporating 3D documentation technology into the site's preservation, maintenance, and interpretation plan. Therefore, the documentation of the architectural masterpiece by Niemeyer has set as a priority to analyze the present condition and the state of conservation of the building, which currently suffers from a lack of maintenance. The impact of digital preservation concerned both cultural and social aspects, and the resulting benefits of such documentation will contribute to ensure that the heritage site will be available and accessible to future generations (see Fig. 06).

The survey had to face the architectural complexity conceived by Niemeyer, who designed the whole building around a large rock situated on the site and that was left there as the binding element of the whole project (KOMAROV, 1975). The result was a design that was modernist in nature, but which contradicted Modernism (NIEMEYER, 2000) at one of its main points that regard creating universal and reproducible architecture, which is not applied to the site. The house is arranged according to the terrain and the feeling is that the architecture is following the contours of the site. The flowing shape of the concrete roof blends with the shape of the surrounding hills. Casa das Canoas was an innovation in Modernism not only in the context of architectural approach and landscape integration but also in the use of technology. One of the main features is the free-flowing horizontal concrete roof, quite thin so as not look too heavy over the glass skin of the living room and resting on small steel supports (WEINSTRAUB&HESS, 2012).

The integrated survey started from the architectural analysis: Oscar Niemeyer's ideologies had formed a unique style (CAVALCANTI, 2003), which he fully expressed in the architecture of the house in Canoas, which in itself was a remarkable achievement of Modernist architecture (PAPADAKI, 1960).

The "reading" of the architecture composition and the 3D survey with high level of detail (2 mm) allows to identifying new ways of "reading" and cross interpretation, such as the triangulation perspective between the artwork placed by Oscar Niemeyer into the indoors and outdoors areas. Thanks to the detailed data capturing, it was possible to identify the axes of relationship that develop from the placement and orientation of the female bodies to encourage to share the environmental and architectural experience.

The 3D integrated survey of *Casa de Vidro*

The first test survey of Casa de Vidro has been developed in 2016 within the cooperation framework between the São Paulo University (especially with Instituto de Arquitetura e Urbanismo – IAU São Carlos – and Prof. Renato Anelli), the Instituto Lina Bo and P.M. Bardi (São Paulo) and the DIAPReM research center.

These first quick campaigns of laser scanner surveys allowed to verifying the feasibility of a full survey on the building towards the restoration and possible insertion of new architectures into the garden as an archive-museum of the Foundation.

The advanced decay of the garden's retaining walls designed by Lina required a particularly-targeted survey which will allow the preliminary assessment of the state of conservation of the structures and can act as a digital archive for those who want to get closer to this extraordinary building which, despite its age, remains incredibly contemporary.

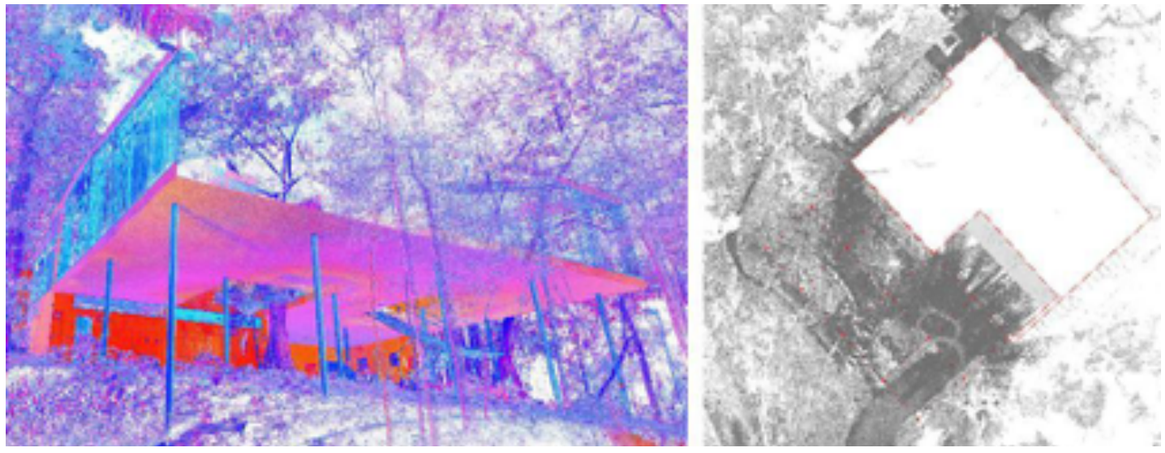

Fig. 08:
point cloud view (right) and first application of the database to check the columns alignment after the first test survey at Casa de Vidro in 2016 (left)

Later, in 2017, a full-3D-integrated survey (both laser and topographic) was planned and carried out by the same partners to achieve the total digital documentation of the house.

As it is known, Casa de Vidro has an important affinity with the work of the masters Mies Van der Rohe (Tugendhat house) and Le Corbusier (ville Sovoye), even if it appears less metaphysical than the Mies' architecture and more linked to the nature when compared to buildings designed by the French-Suisse architect. Following its characteristics, the survey had to take into consideration the different architectural features: from the slim metal columns supporting the front of the house, which is defined by the horizontal planes of floor slabs, to the relationship of architecture and nature.

The second 3D survey allowed also the study of the structure of the house, designed to disappear with its 17 centimeters diameter of pipe columns and the light staircase hanged in the air giving a mobile and provisional feeling about its fragile design, a solution also used later for the MASP project (DE OLIVEIRA, 2014).

Fig. 09: pictures of the 2017 integrated survey at Casa de Vidro by DIAPReM Center

Fig. 10:
3D elaboration from point cloud showing the garage, the studio, Lina's and keepers houses that were subjects of the research project

The survey carried out in 16 working days was based on a multiple methodological integration in order to obtain a set of data to be critically investigated in depth:

1) 3D scanner survey aimed at generating a point cloud model;

2) detailed topographic survey of the homology points;

3) high-resolution photographic survey aimed at an overall and detailed documentation of the house's state of conservation.

The scanner stations points were selected so the individual scans could gather the most metric information and the highest number of homology points (target) allowing, subsequently, a better alignment during registration.

The three-dimensional survey was performed using a Leica P30 scanner (speed: 1mln points / s, accuracy on single measurement: 3mm / 50m, linear error <1mm, maximum acquisition distance: 120m). On the external portions no particular difficulties have been detected in data acquisition; however, great attention was paid to the garden paths (sometimes less accessible due to the inclination of the ground). A detailed topographic survey (based on targets acquisition) composed of open polygonal with control points for the targets was also completed (carried out by Leica total station TS11 R1000). The survey campaign has been documented by a detailed photographic survey.

In total, 135 hours of data capturing were performed on site, 197 scans were carried out, and 296 targets were used; the total measured coordinates were 8,430,499,869.

The alignment phase allowed the recording and the combination of the data: the resulting 3D model is made up of more than 8 million points (xyz coordinates) which refer to a system of local coordinates. In addition, the individual points are accompanied by a specific reflectance value.

The overall cloud can be queried at any time both in the source software (Leica Cyclone 9.2.0) and in many other softwares compatible with the original imp format. The registration phase followed the on-site metric survey of the house and it took more than one month to be completed. The analysis phase dealt with the topic of visual and analytical querying of the data. The process placed therefore a preventive constraint on the obligatory determination of useful and necessary reference plans in order to extract data in the form of horizontal and vertical sections for understanding morphology relations.

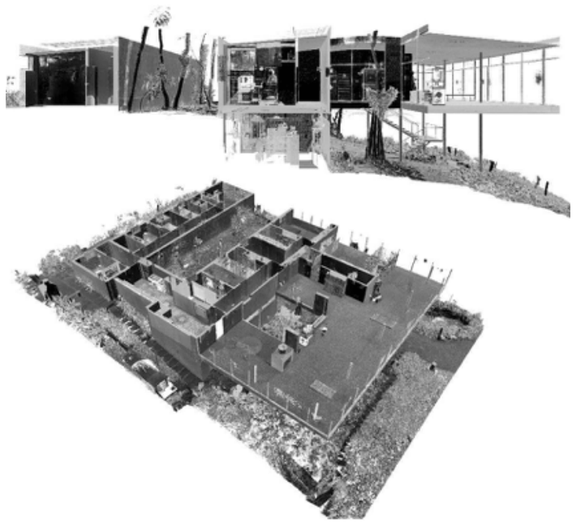

Fig. 11:
vertical (top image) and horizontal sections of the Casa de Vidro

point cloud, perspective views by database inquiring

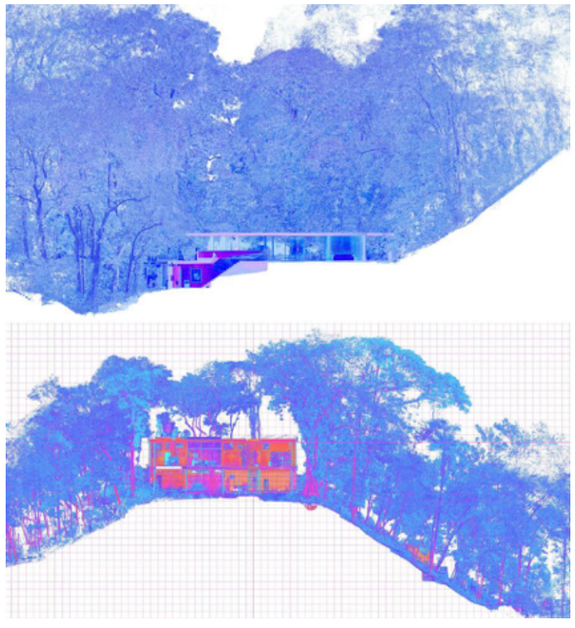

Fig. 12:
point cloud sections of Casa das Canoas (top image) and Casa de Vidro: vegetation and topography

of the two sites play a crucial role in the architectural projects respectively by Oscar and Lina

The relations that link the wall thicknesses to the huge window frames according to the xy cutting planes (horizontal sections) and the relations that bind the patio and the slim columns on the xz-yz cutting planes (longitudinal and transversal vertical sections) were accurately determined.

As it happened during the work on Niemeyer's Casa das Canoas, also with Lina's Casa de Vidro,, while dealing with the database, it became even more clear the strong unity between the outside and the inside, the natural and the artificial that is expressed through the integration between the house and the hill where it is located, one of the driving forces of the design. It was not just a matter of reating a beautiful setting around the dwelling; by looking at the garden she planned, the data showed how she wanted to make the house part of the landscape.

The house is nowadays surrounded by greenery from all sides, and this was one of the major difficulties of the survey. The winding paths in the gardens provided numerous routes for a walk, but at the same time many trees were more than an obstacle for the laser scan. The project is designed to fit the topography of the site by exploiting the full potential in terms of isolation and immersion into the nature and, at the same time, let the vegetation enters and appropriates architecture, integrating it. Thanks to several cross sections extracted from the database this relation is finally precisely determined.

The digital geometric model was also the basis for processing the intensity values acquired by laser scanning instruments; this method of analysis was an essential integration to the macroscopic investigations in order to manage additional information related to surface characteristics displayable on the point cloud.

Each point acquired with the laser scanner has an intensity value attached to it, which is calculated within the range between -2048 and + 2048 (pts export) related to the range of 0-1 (ptx export).

Considering intensity as measured by the scanner, intensity as recorded by the software, and intensity as visualized by the software, and also considering that different scanners can have different intensity characteristics (minimum, maximum, response curve, etc.), a set of analysis on the point cloud of the house has been performed.

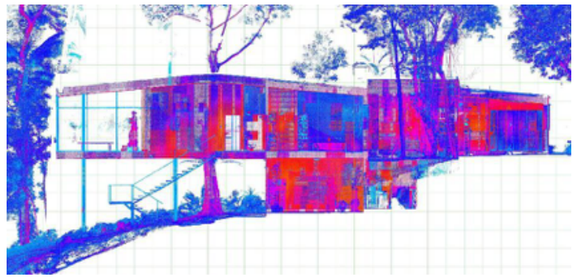

Fig. 13:
the very dense point cloud allows cross sections of Casa de Vidro at high resolution: the building could be redrawn on a 1:20 scale without losing details

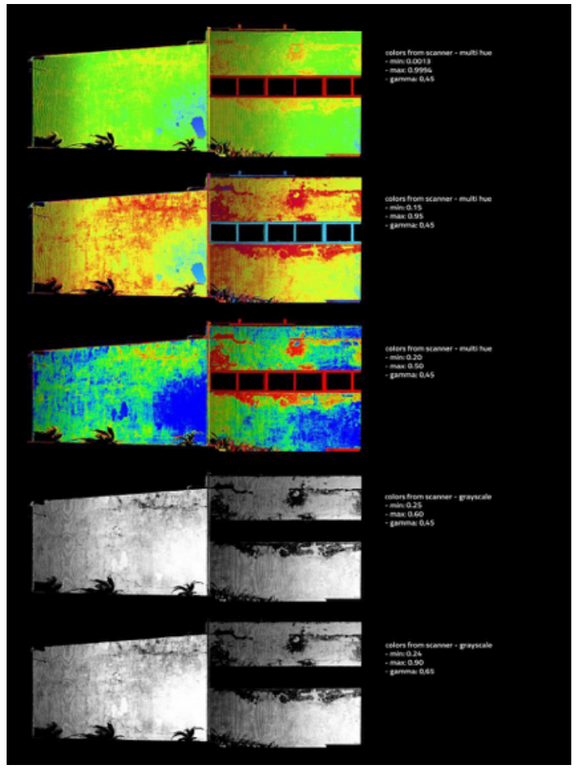

Fig. 14:
elaboration of the reflectance data by several methods aimed at visualizing and analyzing the surface characteristics

According to instrument's specifications (Leica P30 laser scanner), different visualizations of the point cloud have been displayed in order to help accentuate variations of surfaces' characteristics, starting from the full range of colors mapped in the software by default.

By changing the intensity range for specific visualizations, the processing of acquired data highlighted areas with specific features to be mapped (different materials, degradations, previous restoration works, etc.).

This methodology has been applied to a limited but highly representative area of one facade, in order to show on a sample surface the potential of the integrated diagnostic survey by exploiting also the processing of intensity values (FANG et al., 2015). The investigations carried out will support future conservation options to be applied on the building.

Furthermore, by combining 3D metric-morphologic models with mapping and image analysis of architecture surfaces it is possible to achieve useful representations and visualization of conservation specifications; three-dimensional representations of Casa de Vidro have been used as an effective tool for studying, detecting and evaluating present conditions and possible conservation strategies. Point cloud models, opportunely processed, not only allow to understand and assess morphological features, but can also be configured as multi-layered 3D databases for multidisciplinary purposes, including visual detections of material specifications and deteriorations by means of high-definition digital visualizations for non-destructive investigations (ALEXAKIS et al., 2015).

The house is currently facing some problems regarding the deterioration of materials. One of the main degradation issues is the besetting of vegetation, which is growing on external walls and on horizontal surfaces due to the local climate, making some cracks visible due to the vegetation pressure. The digital survey campaign, including the external areas and the garden, has been integrated by a diagnostic survey to map the state of conservation and the main degradation issues.

After a first general inspection of the whole building, a macroscopic analysis of deteriorations has been implemented on the basis of the nomenclature of the UNI Normal 1/88 recommendation. The result of the visual analysis will be related to the surface specifications surveyed by means of the 3D laser scanning and particularly through reflectance data (BALZANI&MAIETTI, 2008).

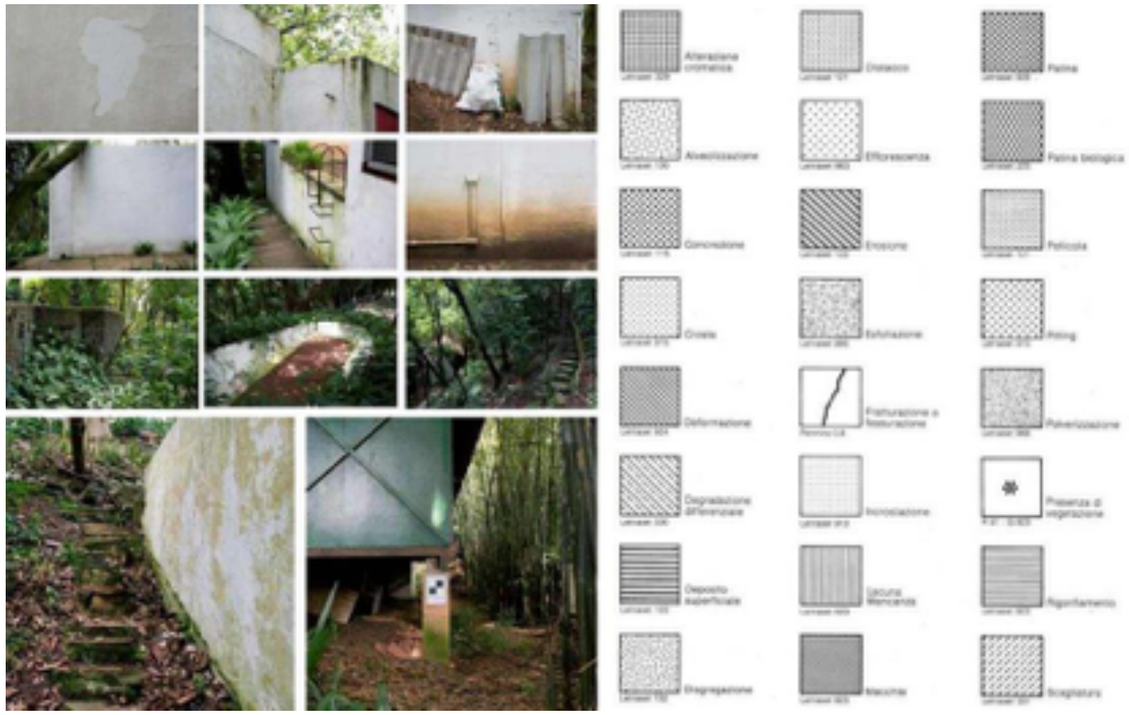

Fig. 15:
main pathologies affecting the surfaces of part of the house

identified during the diagnostic survey

The vegetation, deliberately integral part of the architecture, determines some consequences, while the presence of moisture damages the building's state of conservation, especially along the external wall of the lower floor.

Besides vegetation, the main degradations surveyed on external surfaces are:

- biological patina and biological crust;
- chromatic alteration;
- surface deposit;
- lacuna;
- deformation and detachment.

The main deteriorations on interior surfaces concern:

- lacuna and deformation of the plaster;
- moisture stains and biological crusts.

Knowledge of the main deterioration causes as an additional "level" of integrated survey will allow a precise mapping of the detected damages and will contribute to conservation actions.

Conclusions

The great opportunity to document and investigate one of the most significant architectural works by Lina Bo Bardi, carried out in cooperation with the Instituto Lina Bo e P.M. Bardi, has shown how the integrated methodology is able to reveal new aspects of the building and to analyze spaces and surfaces by means of innovative methods that have allowed to tracking intellectual paths completely unexplored and unpublished.

The three-dimensional survey has proved to be essential to represent areas that otherwise would be impossible to analyze, for example elevations immersed in the trees, especially because of the surrounding landscape, and to find planimetric matches essential to understand the architectural "philosophy" on which Lina based the design of the house.

In the representative phase there is a motivational value, which makes the survey-representation a real project itself, with significant critical implications aimed at the determination not only of geometric precision but, especially in regard to architecture, of visualization and conceptual representation of reality. For instance, by elaborating the database, it was also possible to highlight some architectural features such as the stairs structure and the precise shape of the pond, both designed by Lina Bo Bardi.

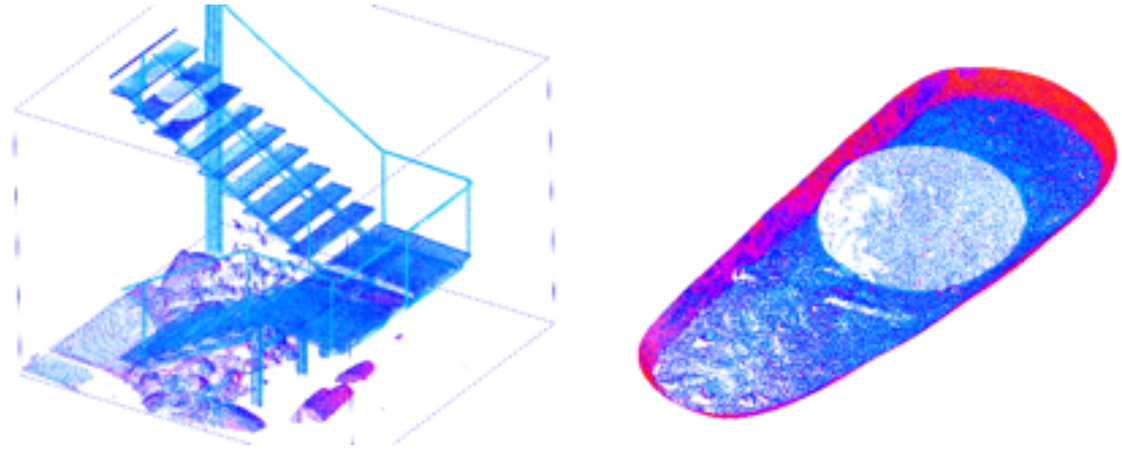

Fig. 16:
extraction of architectural element from the database: stairs structure and the pond.

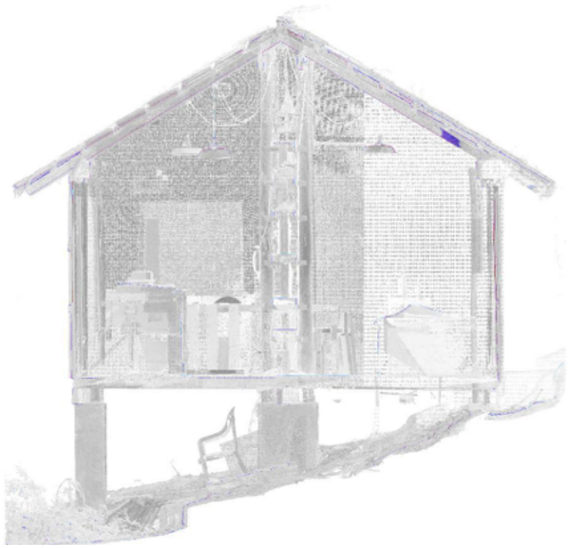

Fig. 17:
cross section in high resolution of Lina's office, one of the buildings of the set surveyed over the campaign

Furthermore, the project was a great opportunity to investigate different methods for the digital acquisition of surface characteristics such as colour, texture, morphology, and macroscopic features of decay through spectrophotometric analysis. The scope should be to identify the possible clues that such surface-recognition may offer, as well as to underlying processes of structural decay. These findings could then be confronted with chromatic data obtained by spectrophotometric analysis.

Some considerations can be outlined in order to point out a possible procedure to exploit the 3D survey methodologies for enhancement and conservation of cultural assets:

- interdisciplinary competences are needed in order to manage survey procedures and cultural heritage analysis;

- outcomes from 3D data acquisition can be a useful integration of non-destructive techniques and monitoring technologies;

- knowledge on deterioration mechanisms acting on original materials and structures and identification of critical areas for deeper investigations is a requirement in order to finalize the 3D acquisition;

- awareness of accuracy and limits of different technologies is the starting point to merge metric survey purposes with a multidisciplinary approach to diagnosis (Maietti & Balzani, 2008).

In this research, the projects also paid attention to defining methods for an integrated use of chromatic and digital structural data for the final BIM model of the house. To explore this possibility, a 30 hours seminar on effective technology and methodology transfer regarding 3D laser scanning activities has taken place at the IAU in São Carlos, during which the staff of the DIAPReM research centre taught the methodology that later helped the staff to independently manage the data elaboration procedures. The topics of the seminar were discussed and chosen in cooperation with local staff and they were mainly related to representation through database querying of facades and plans of the whole building. Thanks to these joint efforts, the 3D survey outputs are going to be a strong base for future management and conservation plan, and it will preserve the memory of this extraordinary house.

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Project credit

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Technical support: Leica Geosystem Brazil (Rio De Janeiro, São Carlos, São Paulo)
In cooperation with: Consorzio Futuro in Ricerca, Italy

General info

Mission start: 23 Jan 2017
Mission end: 11 Feb 2017
Days of work: 14 working days
Hours of work: 168 working hours
Technicians: 2

Survey data

Equipments: Leica P30 + Leica total station TS11 R1000
Time of data capturing: 135 hours
Number of stations: 197
Number of targets: 296
Number of points (coordinates): 8.430.499.869

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Upon completion of the first stage survey, in November 2018, the plan was presented to the Instituto Bardi, emerging suggestions for revisions and additions. This volume, with new graphic design and expanded content, is the result of the review conducted between March and August 2019.

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