

Oscar Niemeyer's Contour-Based Drawings for Curvilinear Architecture

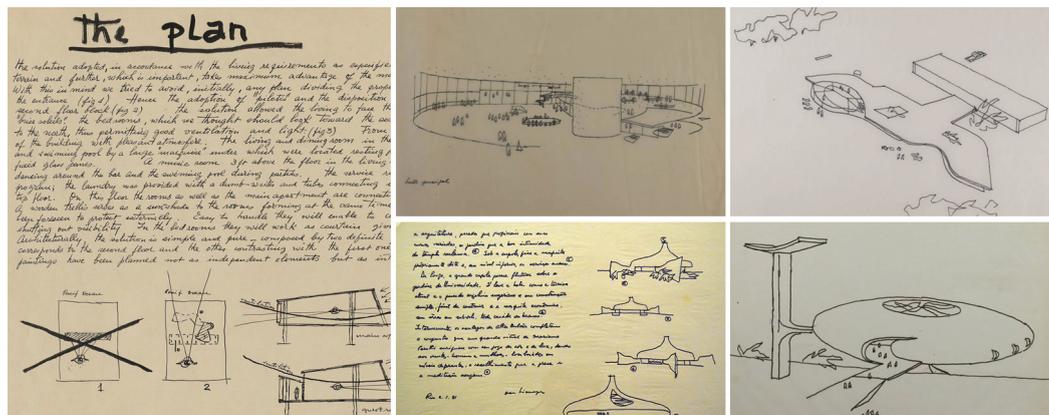
Wilson Florio

Abstract

Niemeyer materialized his ideas using schematic drawings to communicate the main features intended for your creation. His abilities to draw curvilinear forms and spaces with a few traces were challenging. This research aims to point out how contour-based representation expresses more with a minimum resource, resulting in a cognitive economy. The profusion of perspectives produced by the architect reveals the significance of clarifying his spatial intentions and valuing the plasticity of free forms. The Niemeyer drawings we selected to be analyzed contain a set of contours that allow immediate insight into his projects. We classified Niemeyer's perspective drawings, which have curved shapes, in four groups: drawings along with written explanations; indoor environments; outdoor environments; aerial views. The architect delineates outlines of floors, roofs, walls, and certain furniture in his inside perspective drawings, while his aerial perspective features solely the primary outlines of the buildings. Beyond the immediate insight into his projects, we note the power of visual representation, which pervades our imagination. We concluded that he typically uses the simplest drawings in his necessary explanations and, in his rhetorical method, the verbal description of his visual representations.

Keywords

Imagination, perspective drawing, curvilinear surfaces, ekphrasis, cognitive economy.



Cover Image (adapted by author from FON)

“L'esercizio del disegno è per l'architettura (ma non solo) una prima forma dell'immagine.”
Vittorio Gregotti 2014

Introduction

The ambiguity of sketches is closely linked to the uncertainty of the design process, which fosters the production of different ideas and stimulates creativity. The sketches are testimonies of that moment of uncertainty regarding the choices that arise. The conceptual sketches, as precious records of this process [Vagnetti 1958], reveal the relentless search for the definition and solution of a still unknown problem.

Drawings clearly reveal the formal aspects investigated by an architect during his design process. Although the ambiguity of sketches induces multiple interpretations, it is possible to note some underlying subtleties in these embryonic drawings. Drawings, as external representations, can help interpret some occurrences in the mental representation. As affirmed Franco Purini, “Il disegno di architettura è proprio il luogo nel quale il pensiero formale si rende manifesto” [1994/2008, p. 33]. In the last few decades, researchers have shown that it is possible to map some cognitive processes that these professionals use [Schön, Wiggins 1992; Oxman 1990; Oxman, Oxman 1992; Goldschmidt 1994; Goldschmidt 2004; Robbins 1994; Suwa, Purcell, Gero 1998; Bilda, Gero, Purcell 2006].

Luigi Vagnetti [1958] and Rudolf Arnheim [1969] contributed to our awareness that graphic expressions are important manifestations of human thinking and not just externally communicated records of thoughts. Consequently, it is essential to consider drawings as a result of thinking in process.

Niemeyer's sketches reveal uncertainties that occurred during the design process, as well as demonstrate how intense a search for the best solution was. Concomitantly, side by side, these unfinished and ambiguous sketches reveal precious ideas related to each project investigated. Sometimes, the complexity of the shape, primarily expressed by a set of smooth surfaces and a sequence of continuous contours, explains the trial and error until a creative and innovative solution that the architect was looking for emerges.

Whereas complexity for architects increased more with contour features than surface features [Devlin, Nasar 1989], a contour line without interruption produces favorable appreciation. The research revealed Niemeyer's impressive ability to draw curvilinear forms and spaces and his compulsive sketching process. In Niemeyer's projects, the formal complexity of architectural features is a function of the number of contours and turns, not the amount of perimeter. As an experienced architect, he often sketched extensively before deciding on a solution, generating numerous ideas for comparison and selection of the most probable ones.

Precedent-based design [Oxman 1994] is the process of choosing useful ideas from past projects, saved and retrieved in memory [Oxman 1990]. Niemeyer, as a skilled architect, had a large repertoire in memory, enabling him to make quicker and more confident decisions in various project scenarios. During the research, we identified the presence of this repertoire in similar projects: a collection of solutions that are based on prior knowledge and are fundamental for design actions.

The Niemeyer drawings of curved shapes that we selected to be analyzed contain a set of contours—a shelter, a path, a ceiling, a human body, mountains, and other kinds of silhouettes—that allow early and immediate insight into his projects.

Research

The examination of the 469 projects listed by the FON (Oscar Niemeyer Foundation) gave rise to the research. However, the survey conducted in magazines and newspapers of the time allowed the identification of another 34 projects not yet registered with the FON. Currently, we have identified a total of 503 projects, both built and unbuilt. This investigation

involved the selection of 1,045 perspective drawings from a total of 1,407 at FON, created by the architect between 1935 and 2001 [1].

Niemeyer's drawings are characterized by gestural quality and proficiency in delineating outlines with minimal strokes. We classified Niemeyer's perspective drawings with curved shapes into four groups: drawings along with written explanations; indoor environments; outdoor environments; aerial views.

The first group consists of powerful words plus drawings that stimulate imagination as well as reminiscences of memories about design process decisions. Niemeyer named this type of inscription as "necessary explanations" to clarify his main ideas about each project. "Once the drawings and sections are complete, I start writing the explanatory text". [Niemeyer 1980, p. 86]. In figure 1, we see some examples. The main highlight of this means of communicating ideas is the complementarity and synergy between written texts and sketches. This has likely occurred because the architect's intuition perceives how powerful it is to use words to convince the audience about his design choices with small sketches and drawings that pervade our imagination.

Ēkphrasis emphasizes the act of making something explicit or manifest and involves vivid, detailed description in the context of explanation [Carruthers 2000]. *Enargeia* embodies the essence of drawings and words, making them vividly tangible, profoundly engaging, and emotionally impactful. Niemeyer used to compose, side by side, words and diagrammatic drawings to quickly promote an idea and convince the audience.

As we can note, the tiny drawings (each one between 3 and 7 centimeters wide), as a

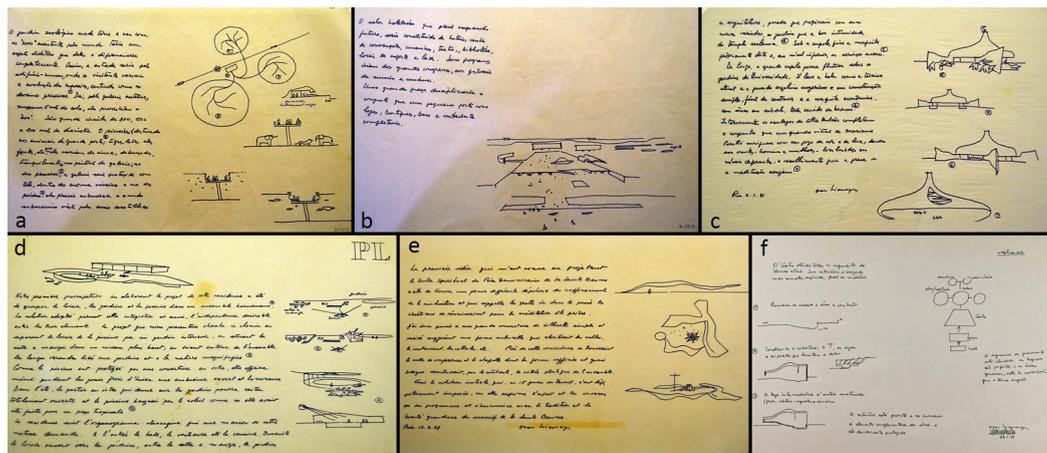


Fig. 1. Drawings along with written explanations (adapted by author from FON).

result of the design process, side by side the phrases about the main decisions, amplify comprehension about the issues presented, as well as express essential aspects of each project. In figure 1, vertical sections (fig. 1a), aerial perspective (fig. 1b), sequence of paths of dislocation (fig. 1c), indoor spaces, sun penetration (fig. 1d), plan view, vertical section, and perspective (1e), and the numbered step-by-step design process (fig. 1f) demonstrate adopted design strategies to explain and convince the audience. In vertical sections, the shelter's contour possesses a structural quality, while in perspective drawings, the building's form, defined by contours, exhibits aesthetic plasticity. The undulating curves signify purposeful organicism, symbolizing the relationship between nature and the constructed surroundings. Powerful words such as "marvelous views", "a music room to dancing around", "swimming pool during parties" [Niemeyer 1948, p. 52.] stimulate our imagination in Tremaine residence (1948) (fig. 2).

If, in fact, "memory delights in brevity," as articulated by Cicero and Seneca, regarding the significance of clarity and conciseness for enhanced memorability and impact, it follows that a drawing composed of few lines conveys much with less. "Contour information is easily and effectively used by us to infer the shape of a surface", affirmed David Marr

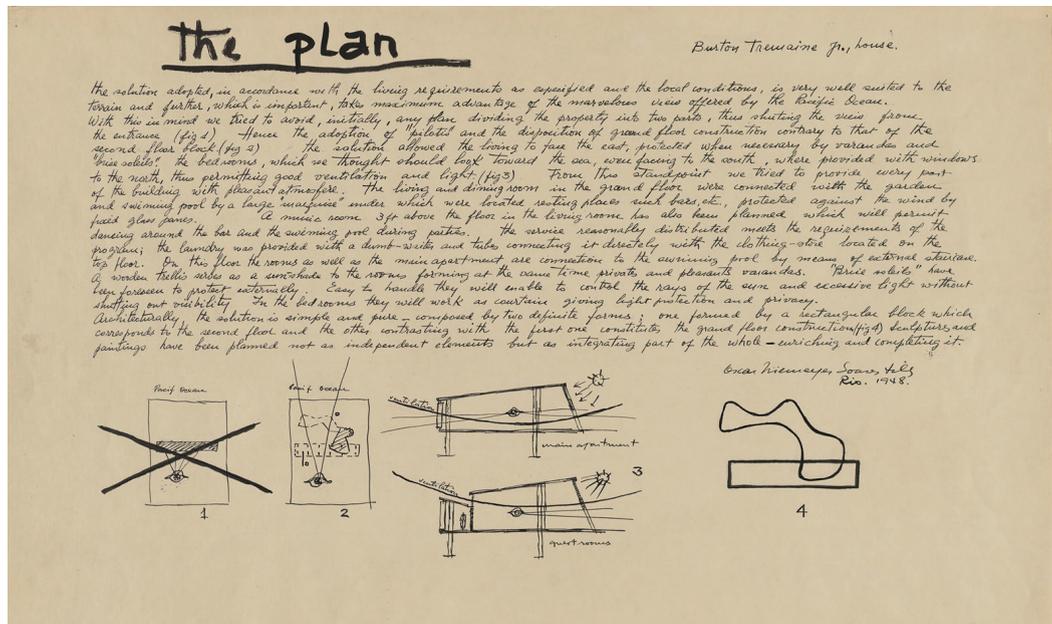


Fig. 2. Words and drawings to explain the marvelous views, sun protection, and ventilation in Tremaine residence, 1948 (FON).

[1977, p. 444]. If the edge-based representations mediate real-time object-recognition [Biederman, Ju 1988], the bounding contour, i.e., silhouette, makes us immediately recognize a form before the surface or its details. As an expert architect, Niemeyer knew the power of a small drawing to persuade a client that what he was trying to demonstrate was more efficient, the best solution for the problem, as well as an inherent beauty of the suggested building. The cognitive economy is produced when we express or do more with a minimum effort. So, we can infer that a quick sketch, a small silhouette, can promote instantly an idea.

Indoor environments are more complex, yielding contrasts of 'solids' and 'voids', ceiling height alternations, organic shapes, transparency and opacity, and rich spatial quality. In figure 3, we can analyze Niemeyer's drawings of indoor environments. It is vital to pay attention to contours that define the spaces. There is an emphasis on transparency that allows a view transition from the interior to the exterior. Human bodies in the interior (or exterior) of the building allow for scale. The amplitude of the field of view is exciting when focusing on an extensive area without distortions. To convey this state of affairs in drawings should not be an effortless task for anyone, but Niemeyer's drawings reveal spaciousness, fluidity, and a pleasant view.

The continuity and smoothness of the interconnected sequence of segments of lines and curves convey both natural and informal silhouettes of physical architectural features. Unfinished silhouettes delineate architectural features. Figure 3b illustrates the cupola of the Congress Parliament in Brasilia as a single curve. Conversely, figure 3a shows the indoor workspace as a series of broken vertical lines and plan level curves that give a sense of scale based on the emphasis of people's bodies.

Niemeyer's perspective drawings show a strategic vantage point and field of view. This enables the viewer to understand the main features of the spaces while imagining movement throughout the building. Internally, there exists a pronounced concern with the transition between covered and uncovered areas, as well as between the interior and exterior—specifically, the accuracy in defining form and the articulation between spaces. Figure 3c depicts a curvilinear path in the interior of the zoo, with human bodies walking and seeing the birds and animals on the exterior through the glasses. The curved contours define a lobby in an airport terminal (fig. 3d), while a set of curves and vertical and horizontal lines define the indoor space of a residence (figs. 3e, 3f, 3i). The opacity planes, depicted by a subtle dotted pattern, contrast with transparent glass (figs. 3d, 3f, 3i). The drawings subtly allude to vegetation, textures, and colors. In all these drawings prevails an economy of traces

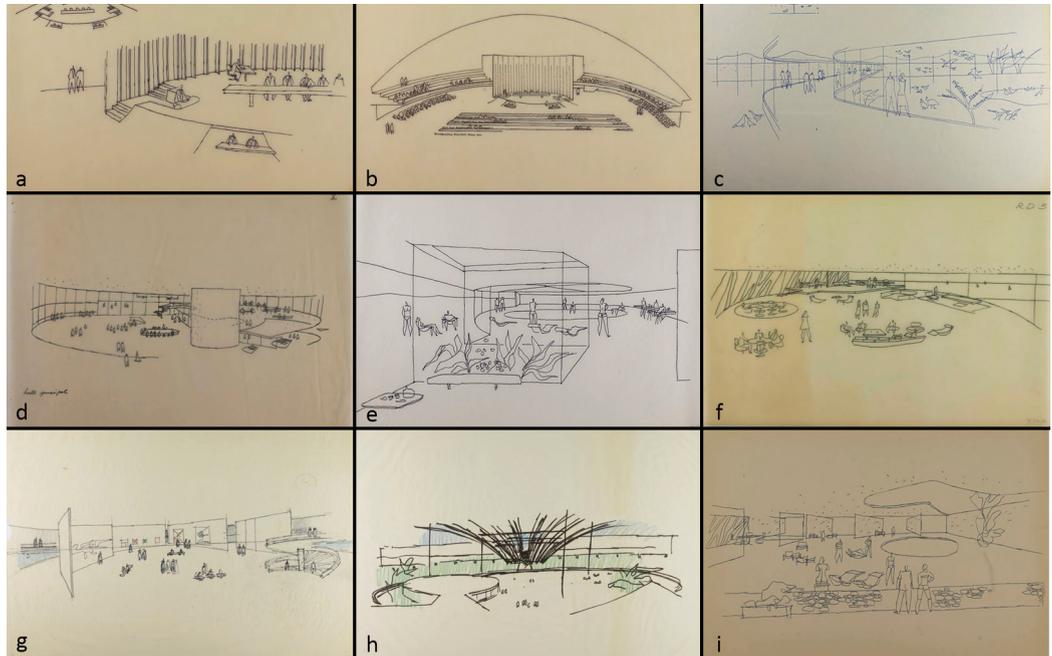


Fig. 3. Indoor perspective drawings (adapted by author from FON).

that are enough to define spaces' contours. Once more, a few contours delineate the forms and spaces, allowing the immediate recognition of objects in the scene.

In figure 4, we can analyze the importance of curvilinear roofs in Niemeyer's oeuvre. The circle, ellipse, parabola, and hyperbola are all geometries that come from conic sections. As a modern architect, he investigated several structural geometric principles in order to achieve a large coveryure without pillars. Contrasts can be observed between rectangular block outlines and curvilinear surfaces. Pathways with human bodies (figs. 4a, 4b, 4c, 4f), horizons delineated by a single curve, and foreground, middle, and background distinguished by vegetation outlines are some characteristics.

Figure 5 contains examples of aerial perspective drawings produced over five decades that reveal the simplicity of contours represented by Niemeyer in his projects. The strategy

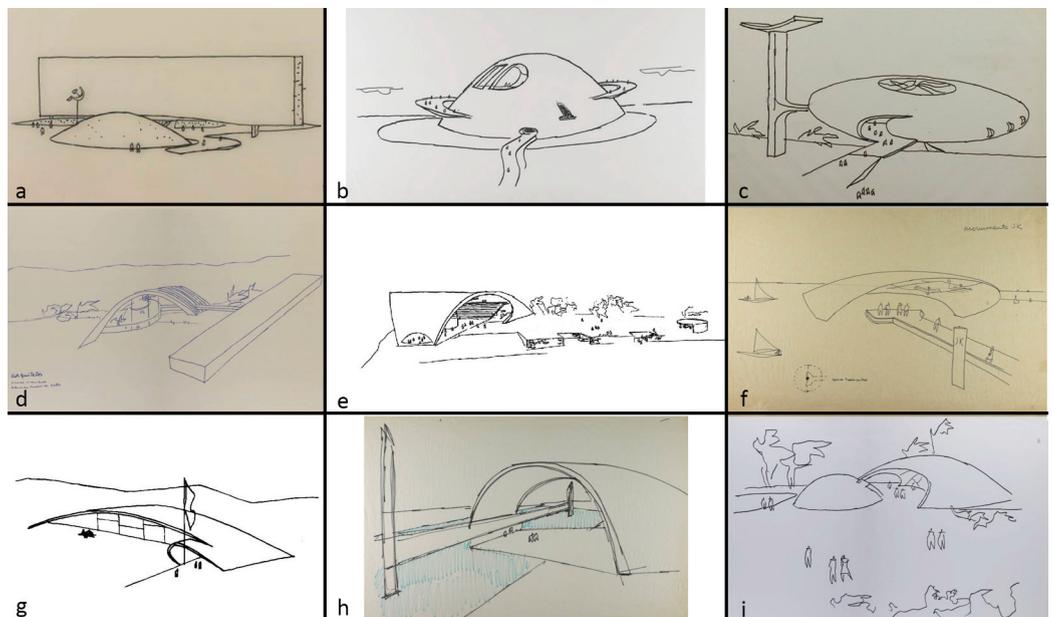


Fig. 4. Outdoor perspective drawings (adapted by author from FON).

involved representing viewing angles, which also served to explain the concept. Aerial representations typically emphasize the roofs as simple and continuous silhouettes. Only a few traces, visible from a distance, represent the buildings, revealing their plastic form intentions. Niemeyer deliberately accentuates the structural nature of structural elements while simultaneously highlighting certain apertures. Always, the architect emphasizes the routes that culminate at the entrance of each building. In these cases, contour-based representation mediates real-time object recognition of outdoor environments with a few keystrokes. All these amazing drawings were a mix between adaptations of precedents and discoveries of new possibilities derived from a lexicon of interchangeable combinations of architectural

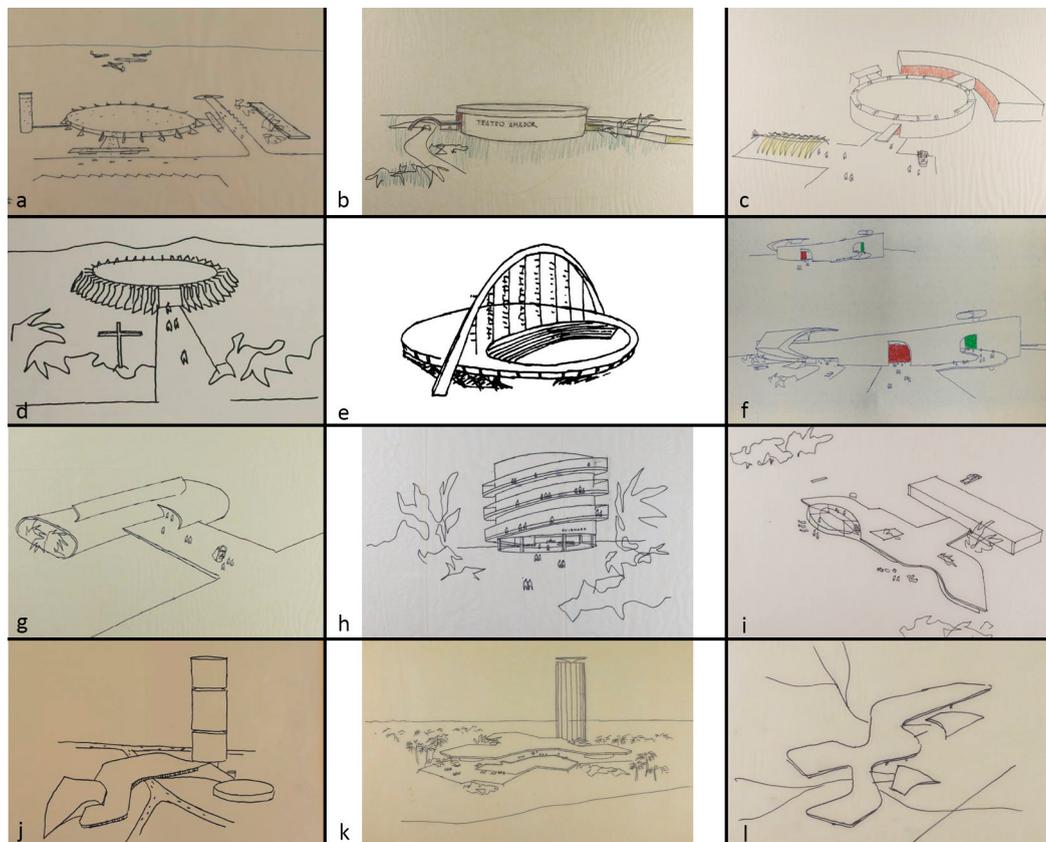


Fig. 5. Aerial perspective drawings (adapted by author from FON).

features and cone-section-based geometries. In reality, it is a compilation of *prior* discoveries, as Alvaro Siza defined it [Siza 1998].

Over the past four decades, studies on preferences [Bar, Neta 2006; Silvia, Barona 2009; Vartanian *et al.* 2013] have demonstrated that, for safety or biological reasons, individuals exhibit a preference for curved things. Individuals see spaces as aesthetically pleasing when they are curved rather than rectilinear; as curvilinear rooms seem more open and expansive, thereby appearing safer and more comfortable. Environmental research [Nasar 1994] also confirms this preference due to a symbolic aesthetic that prefers naturalness –the natural over the artificial. Unconsciously, Niemeyer’s architecture exhibits these preferences: an innovative approach to curved shapes, whether in his buildings or in his furniture.

Discussion

There is no doubt that Niemeyer’s abilities to draw curvilinear forms with a few traces were challenging. However, as an expert architect, Niemeyer knew how to materialize his ideas quickly using powerful, schematic, diagrammatic and expressive drawings to communicate

the main features intended for your creation. He explored the contour information to easily and effectively infer the shape of his curvilinear surfaces. Thus, we don't find 'rendered' perspective views in these projects, probably because the major impact should be derived from the novelty and surprise elicited by the expressive forms and spaces.

Although the curved roofs' plasticity stands out in their projects, the architect explored a variety of geometries, particularly free forms, interconnected curves, and lines. This fact requires considerable effort and a master ability to represent three-dimensional curves in perspective. In addition, drawing by contours reveals the aim of maintaining criteria for simplicity and plastic freedom [Niemeyer 1960], which the architect believed characterizes his buildings.

The majority of the drawings in his presentations resulted from a rigorous design process, including the generative phase of several ideas followed by an exploration phase in which the most representative drawings were selected. Whereas the imagination is influenced by existing knowledge frameworks in the architect's mind, his schematic drawing has a capacity to incite our imagination due to its incomplete elements and allows us to access a repository of thoughts embedded in our memories. Indeed, it is a genuine energeia: the potency of visual representation that permeates the user's imagination.

Niemeyer used conventional methods of representation to fulfill his expectations. However, the words used in his visual drawings have a significant impact. There is no doubt that the abundance of perspective drawings and selected words highlight the significance of clarifying his spatial intentions and valuing the flexibility and novelty of free forms.

The architect typically uses the simplest drawings in his necessary explanations, primarily due to their immediate relationship with the text, their ability to illustrate the fundamental aspects of the project, and their ability to stimulate imagination. Thus, the quality of his texts, along with drawings, produces a clear, striking, and lively image in the mind of the observer of his perspective drawings.

On one hand, the simplicity of his drawings guarantees immediate comprehension of his ideas; on the other hand, contour-based representation helps people recognize his buildings in real time because the drawings say more with fewer graphical resources. Niemeyer delineates the outlines of floors, roofs, walls, and certain furniture in his inside perspective drawings, while his aerial drawings feature only the primary outlines. This fact demonstrates that consciously the architect drew only strict contours related to the distance in order to communicate his intentions.

Notes

[1] Project A *Geometria das Colunas, Rampas e Coberturas Curvilíneas nos Projetos de Oscar Niemeyer*. Research funded by the National Council for Scientific and Technological Development, CNPq. Principal Investigator: Wilson Florio (Universidade Presbiteriana Mackenzie). Research organization: Universidade Presbiteriana Mackenzie, Brazil. Funding period: 5/12/2014-31/12/2016. <https://app.dimensions.ai/details/grant/grant.9241863?lang=pt>.

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Author

Wilson Florio, State University of Campinas, wflorio@unicamp.br

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