

Idea, Form, and Structure: Frank Lloyd Wright's *Archeseum*

Cosimo Monteleone

Introduction

The design of the Guggenheim Museum had a long and troubled history. The building was strongly opposed by supporters of the International Style due to its revolutionary and innovative nature [1], but Frank Lloyd Wright strenuously defended his idea, presenting it to public opinion as the only example of Organic Architecture [2] in New York [Dal Co 2004, p. 27].

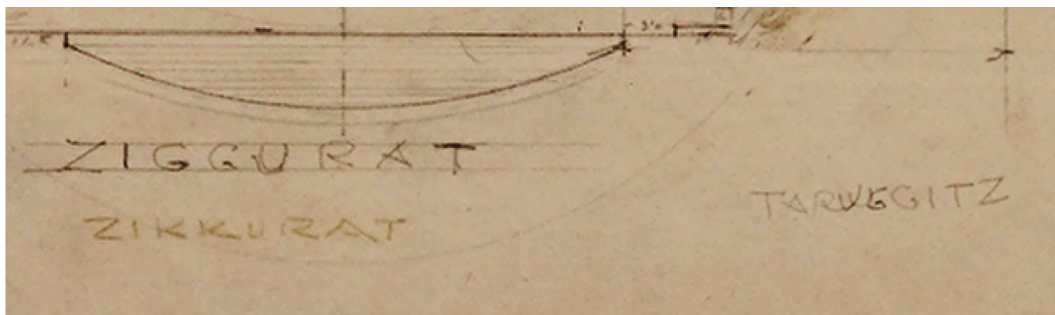
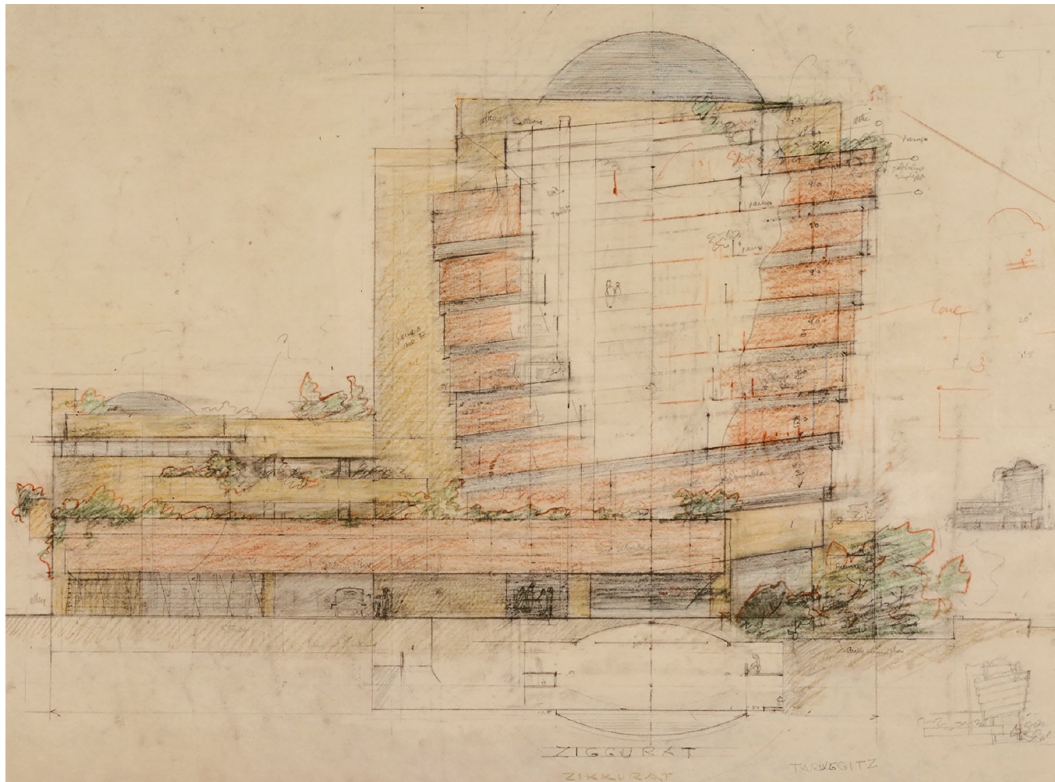
The initial planning constraints were roughly the following: having to build no further than Midtown, the building would have belonged to the rigorous New York Hippodamian grid, so, in spite of himself, Wright was forced to fall back on the idea of a compact and vertical museum.

He had already developed the main characteristics of his project [Ballon 2009, pp. 19-37] even before deciding on a location on the Upper East Side facing Fifth Avenue on a lot between 88th and 89th Street. The decision to organize the museum around two nuclei, a larger one, the Archeseum, the majestic exhibition space, and a smaller one, called the Monitor Building, the latter created to house the offices, came after very rapid steps. In fact, at the end of 1943, in the thick correspondence addressed to Solomon Robert Guggenheim, the client, and to Hilla von Rebay, the first curator of the museum, the architect's enthusiasm immediately became clear [Brooks Pfeiffer 1986, p. 25].

This article was written upon invitation to frame the topic, not submitted to anonymous review, published under the editorial director's responsibility.

Fig. 1. F.L.I. Wright, Guggenheim Museum: drawing, 1943, code 4305014 (courtesy of Avery Library, Columbia University, New York).

Fig. 2. F.L.I. Wright, Guggenheim Museum: drawing, 1943 code 4305014, detail (courtesy of Avery Library, Columbia University, New York).



Idea and form

A drawing, performed during that period of intense fervor, shows the architect's complete vision (fig. 1), quickly expressed through the representation of the main facade facing Fifth Avenue. In the large exhibition hall, the nerve center and complex hub of the building, Wright presents the observer with a dual vision. The strokes of color, which entirely characterize the graphic rendering of the facade, break toward the center, following the contour of a wavy line, to make room for a thin pencil line. In this way, the architect simultaneously depicted both the interior section and the exterior elevation.

A small note in the drawing clarifies how the author did not miss the semantic and formal relationship of his idea for the Guggenheim Museum with an archetype of biblical architecture, noted in the words written at the bottom: "Ziggurat" and "Zikkurat" later transformed into "Taruggitz" (fig. 2). The inversion of the letters in Wright's neologism clearly testifies the desire to invert the archetypal form of the ziggurat [Carranza 2009, p. 94], usually composed of recessed steps but transformed in the Guggenheim into an inverted truncated cone. The inspiration provided by this important drawing opens the possibility of tracing, through analysis of form and structure, the genesis of the architect's mental journey through the labyrinthine meanders of his thought.

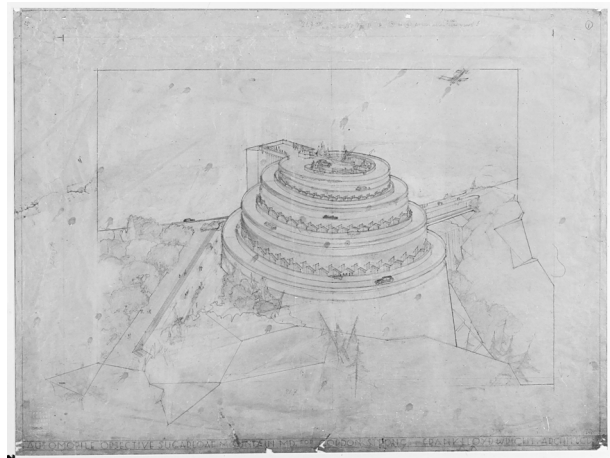
If, in general, retracing the struggle behind the design concept means identifying and highlighting the causes that infused form and meaning into a building, this backwards journey is even more desirable for the Guggenheim Museum, since its original idea has retained its character unchanged for more than a decade, despite the negative opinion of numerous and illustrious colleagues of Wright, which, in some ways, was also followed by the irony of public opinion [Dal Co 2004, pp. 27, 28].

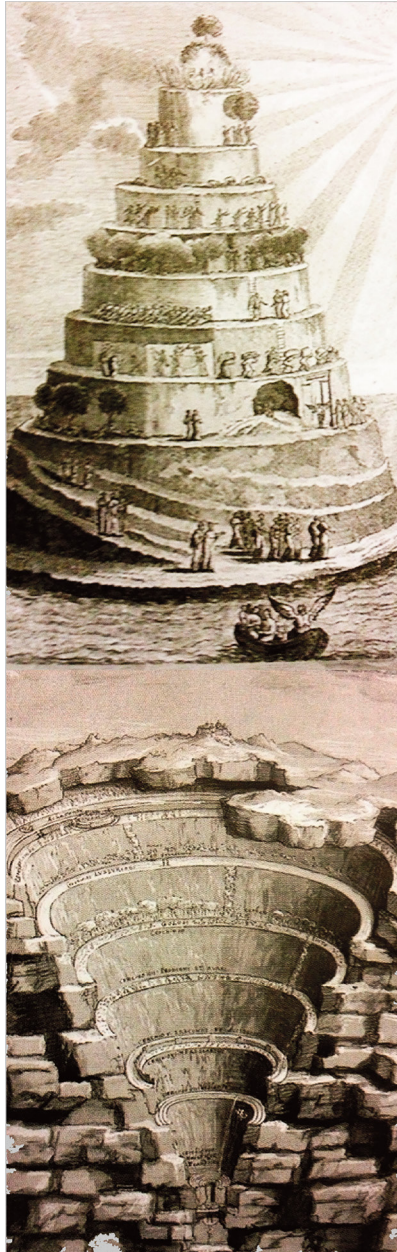
The importance of this drawing, accompanied by a simple written note reminiscent of childhood anagrammatic puns, did not escape Francesco Venezia, who expressed himself in this way: "What may appear to be a joke, a funny pause in the process of conceiving the project, reflects an important change [...]. The primitive form of the ziggurat, an original form, biblical and Mesopotamian –the mass that diminishes as the height increases– changes, with the elementary immediacy of the mirror reversal, into an absolutely new form: the mass now grows upwards. The Guggenheim is born, unmistakably!" [Venezia 2012, p. 36].

The initial idea wasn't so immediate; the early stages of its birth are rooted in a long process of development, dating back to the mid-1920s; during this period, the archetypal theme of the ziggurat had already surfaced in the American architect's memory with the project entitled Gordon Strong Automobile Objective and Planetarium (fig. 3). To better understand how these aspects are also linked to the New York museum, it should be noted that only the development of concrete and the subsequent revolution sparked in the field of construction by reinforced concrete offered Wright the opportunity to reconfigure the forms sedimented in his childhood, to overturn an archetype and transform the Guggenheim Museum into 'taruggitz'.

In the United States, one of the most widespread uses of reinforced concrete, composed of cement and iron bars, was the construction of helicoid ramps for the first urban parking lots. These surfaces allowed cars to be driven from the ground floor to the roof, and we know that Wright immediately looked with interest at this type of solution, because he associated the continuity of the material with experiential continuity. The fact that reinforced concrete and its innovative uses for the creation of ramps were a source of inspiration for the American architect is evidenced by some writings jotted down years after a visit to the Ford Motor Company in Detroit, a building designed and built

Fig. 3. F.L. Wright, *Gordon Strong Automobile Objective and Planetarium*, drawing, 1924, code 2505053 (courtesy of Avery Library, Columbia University, New York).





by Albert Kahn, for whom Wright had always had great respect [Brooks Pfeiffer 1992, p. 55].

Thus, long before the Guggenheim Museum was commissioned, after having glimpsed the possibilities introduced by reinforced concrete, Wright was inventing ways to shape the material beyond appearances and beyond the known. Essentially, he set out to find geometric configurations that would allow him to express the movement and dynamism of space with a fluid and plastic gesture. Regarding the Guggenheim Museum, Francesco Venezia astutely points out that, during his formative years, Wright had already witnessed the representation of the inversion of a ziggurat in 'taruggitz', leafing through the pages of the translation of Dante Alighieri's *Divine Comedy*, illustrated by the poet and artist William Blake [Venezia 2012, pp. 48-60].

Wright had a particular predilection for Blake [Monteleone 2013, p. 28], but there is also irrefutable evidence demonstrating a profound knowledge of what can be considered the magnum opus of Italian literature. The connection is offered by Victor Hugo's *Notre-Dame de Paris*, which Wright had discovered in his youth. The passage in which the French writer announces the advent of a great architect of genius who would play the same founding role in the twentieth century that Dante had in the thirteenth [Hugo 1831, p. 207] certainly did not leave Wright indifferent [Monteleone 2013, p. 19]. Indeed, given the American architect's notoriously overblown ego, there is no doubt that he considered the celebrated French writer's prophecy a premonitory sign of his own personal contribution to the renewal of architecture. This consideration would have led to the conviction that his work had undertaken a marvelous feat, comparable to that accomplished in literature, some seven centuries earlier, by Dante Alighieri. Wright, therefore, may have discerned in Blake's images, which depicted the formation of purgatory as a result of the excavation material from the hell (fig. 4), the seed of the inversion that characterizes the anagrammatic play on the word ziggurat in 'taruggitz', proudly noted in the margin of his study drawing, to indelibly mark the profound formal revolution of the Archeseum.

As proof of the validity of these literary references it is worth considering a passage from a speech by Wright, given at a time when there was no suspicion, which reveals his faith in the idea that only new technologies could trigger a revolution in architecture, comparable to that sparked in

Fig. 4. W. Blake, *Formation of Purgatory and Paradise* [Blake 1838, p. 11].

the world of literature by the most illustrious exponents of all cultures. According to the American architect, the new materials used in human machines had characterized the physical essence of our time, distinguishing it from previous centuries [Wright 1901, p. 80].

But there is another illustration by Blake, which, in an even more evocative way, could have stimulated Wright's fervent imagination in the development of a helicoid ramp for his museum. This image, in some respects, possesses the same miraculous quality as the suspension effect embodied in the Archeseum; it is a representation entitled *Jacob's ladder* and describes Jacob's dream vision (fig. 5), contained in the book of *Genesis* [Blake 1794]. The episode in question is the following: Jacob, after a long journey on the road to Charan, decides to camp in an unspecified place. During the night he dreamed of a ladder resting on the earth, whose top reached the sky, crowded with angels ascending and descending.

How can we not connect William Blake's elegant interpretation of Jacob's dream, centered on the design of a ladder that stands on its own until it disappears into the clouds, with the exhibition at the Guggenheim Museum?

But once we've established that this miraculous effect was meticulously sought in the *Archeseum*, it's worth analyzing the elements that made the architecture possible.

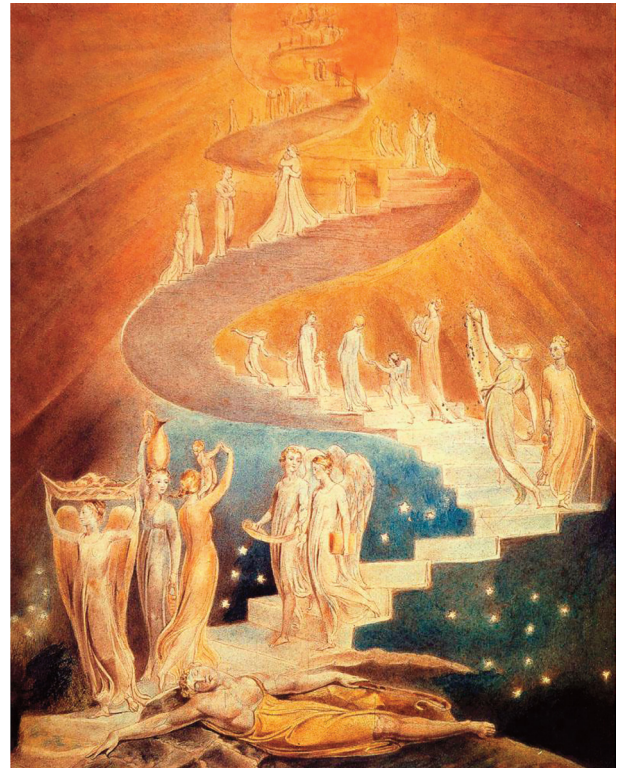
Form and structure

Passing from idea to construction, the Archeseum gathers and fuses the following compositional elements into a dynamic and elastic structural unit: the helicoid ramp, the twelve radial structural partitions, and the dome. Wright's tectonic solution undoubtedly seems aiming at the expressive quality of the interior space, relying on the stunning effect created by the helicoid ramp, apparently solved without pillars and beams, which would have evidently compromised its continuous and enveloping character. From a technical and technological standpoint, the so-called 'helicoid elastic beam' had already been the subject of in-depth speculation at the beginning of the 20th century [Markus 1914] and, as we have also had occasion to highlight, repeatedly applied in the automotive industry to solve the parking problem in increasingly congested American cities. In addition to the undoubted practicality of being able to connect levels at different heights without interrupting the motion, the particular spatial configuration of a helicoid

beam implies a further advantage from a static and structural point of view, since the contributions triggered by the normal and shear stresses generate a redistribution of the loads, compensating for the values of the torsional moment and producing overall stresses that are significantly lower than those that would occur with overlapping ring beams [Belluzzi 1942, p. 253].

From a structural point of view, the ramp of the Guggenheim Museum behaves exactly like an elastic beam with a helicoid development but, even if the structure apparently uninterruptedly envelops the space of the central cavity, it is necessary to point out that the continuous growth of the helicoid surface occurs only for 270 degrees of the base circle, first projection of the helicoid, while the remaining

Fig. 5. W. Blake, *Jacob's ladder* [Blake 1838, p. 16].



90 degrees, corresponding to the stairs and elevators, interrupt the development of the ramp, replacing it with a classic system of overlapping levels supported by pillars (fig. 6). The entire helical path, from the first level to the top, intersecting in the ascent with the twelve radial partitions, collaborates closely with the latter, which are entrusted with a dual static task: that of supporting the upper spirals of the ramp and at the same time stabilizing the lower ones, generating an overall union which, exploiting the radial pseudo-symmetry of the structure, proves to be considerably solid and firm [Trombetti 2007, p. 50]. From a static point of view, what raises the greatest doubts is the theory of triangular partitions with an inverted shape. In fact, if these vertical elements served throughout their entire development to support the normal stress triggered by the helicoid ramp, then, as they approached the ground, they would have to present an increasing cross-section to adequately cope with the loads accumulating from above. However, the opposite occurs, so much so that, at the base of the building, the cross-section of the partitions is characterized by a practically inconsistent size (fig. 7). Interestingly, from the first to the third level, the radial partitions, and consequently the helicoid ramp, are surrounded by a cylindrical band, whose static behavior can be likened to that of the drum of a dom. This external band serves as a substitute for the twelve triangular elements in the role

of load-bearing structure for the vertical loads. The radial partitions, therefore, from the first to the third level rest on the surrounding cylinder for the entire 270-degree arc, while they hover as true, independent load-bearing elements from the fourth level up to the summit (fig. 8). The inseparable collaboration between the external cylindrical belt and the radial partitions emerges from the words of Tomaso Trombetti, who conducted an in-depth study of the load distribution in the *Archeseum*: "Assuming that the partitions have a vertical load-bearing function, one can therefore imagine a progressive transfer of vertical forces from the partitions themselves to the drum at the first three floors of the building. This transmission of vertical forces to the drum also allows for the uniform distribution of the vertical forces discharged from the structure to the ground at the base ring, thus improving the functioning of the foundation system as well" [Trombetti 2007, p. 52]. The technical solution implemented by Wright evidently has a very specific intent from a figurative and formal point of view. In fact, the use of such a complex load-bearing structure, consisting of the collaboration between the twelve inverted triangular elements and the cylindrical band that surrounds them at the first levels of the building, allowed their designer to create a sort of optical illusion that makes the helicoid ramp appear as if it were suspended throughout the volume of the central cavity, in

Fig. 6. Plan of the Archeseum. The image shows the 270-degree helical ramp and the 90° cantilevered floor (graphic elaboration by the author).

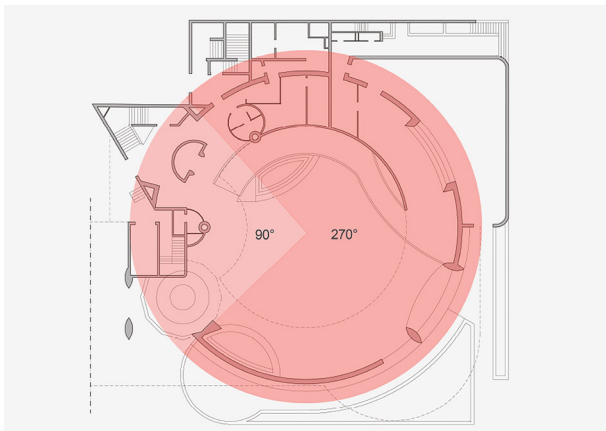
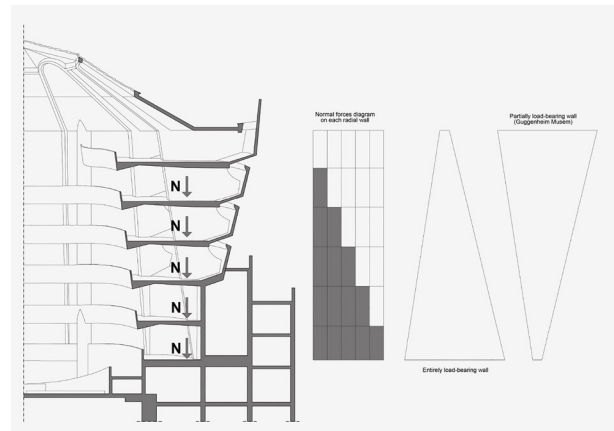


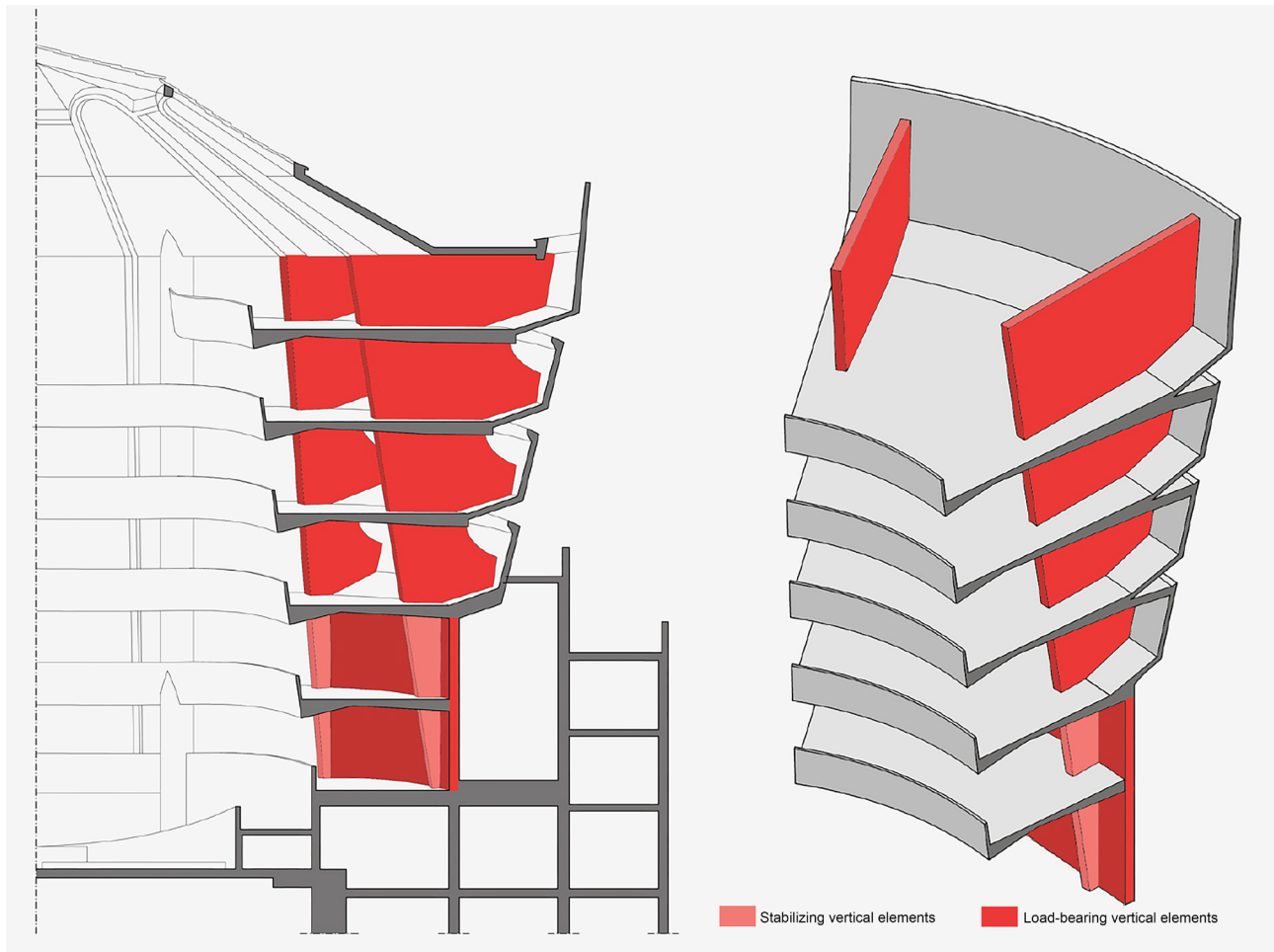
Fig. 7. Radial walls of the Archeseum: analysis of normal forces (graphic elaboration by the author).



the act of self-supporting. In addition to the partitions, the helicoid ramp is also subjected to specific stresses. In fact, being embedded every 30 degrees to a pair of triangular supports, it has a longitudinal section subject to a bending moment, caused by the presence of the cantilevers that increase in size towards the inside, as one ascends to the top [Trombetti 2007, p. 53].

But if on the one hand the inward cantilever produces a negative rotational force at the longitudinal section of the ramp, on the other it is still an overhang, in this case the external masonry, that cancels out the stresses in the same section confirming the synergistic behavior of the entire structure (fig. 9). The collaboration between the analyzed elements must evidently have been very

Fig. 8. Radial walls of the Archeseum: analysis of load-bearing behavior (graphic elaboration by the author).

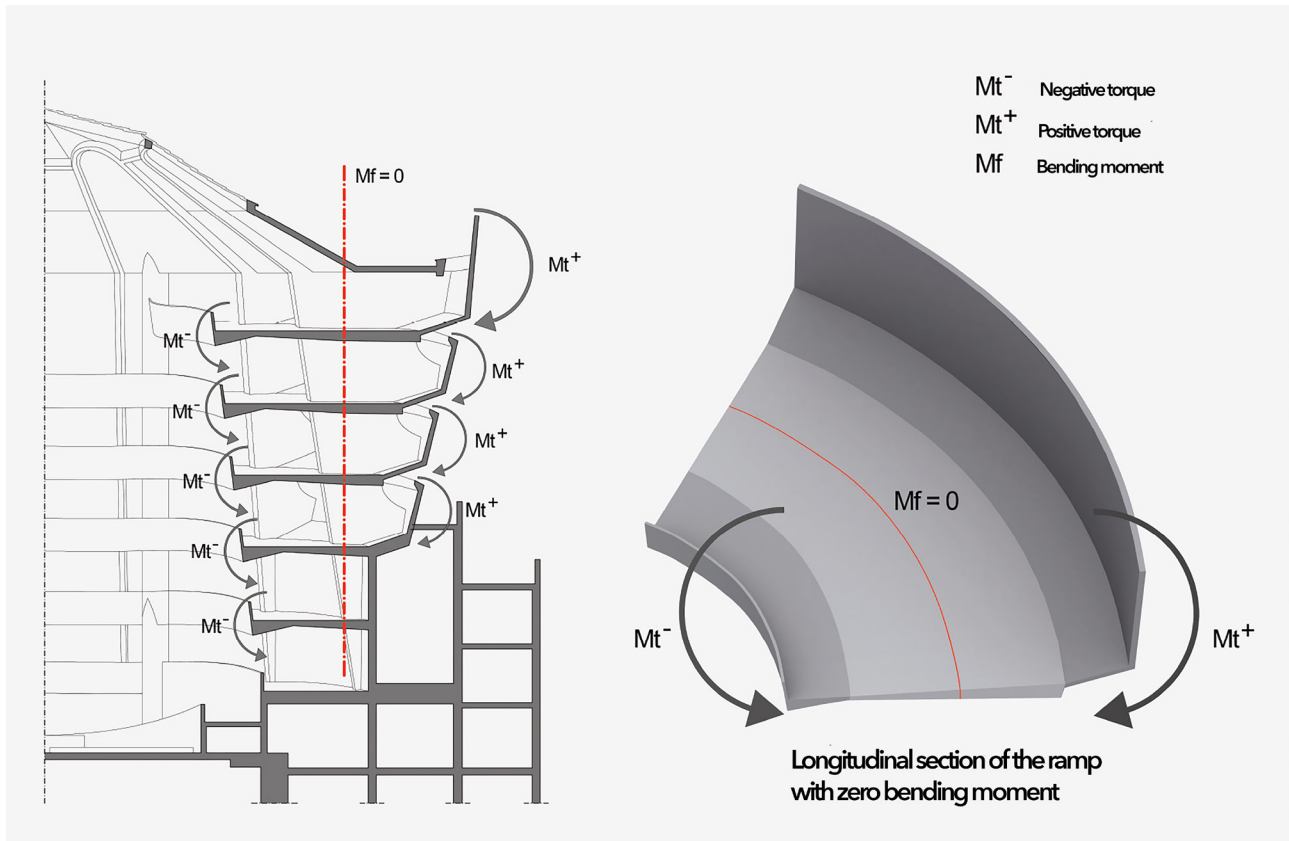


carefully considered by Wright from a static point of view, since the longitudinal section of the helicoid ramp, despite being the geometric location where vertical stresses are most felt, is characterized at every point by a zero bending moment, even though the exhibition path increases its width by ascending, rotating, and translating.

This extraordinary balance was achieved only thanks to the increasing progression of the triangular partitions, which allow for an ever-increasing portion of the ramp to be accommodated while the internal and external overhangs maintain their mutually constant dimensions

on each level. This is why, being subjected to the same opposite torsional moments at every point, the helicoid ramp exhibits a bending moment equal to zero along its entire longitudinal section. This requirement for balancing the longitudinal section of the helicoid ramp also explains the formal reason why the triangles, which constitute the twelve radial partitions, have differently inclined sides – specifically, the internal one by 11 degrees and the external one by approximately 22 degrees. According to Trombetti, proof of this assumption could be attributed to the reduced inclination of the last volute of the external

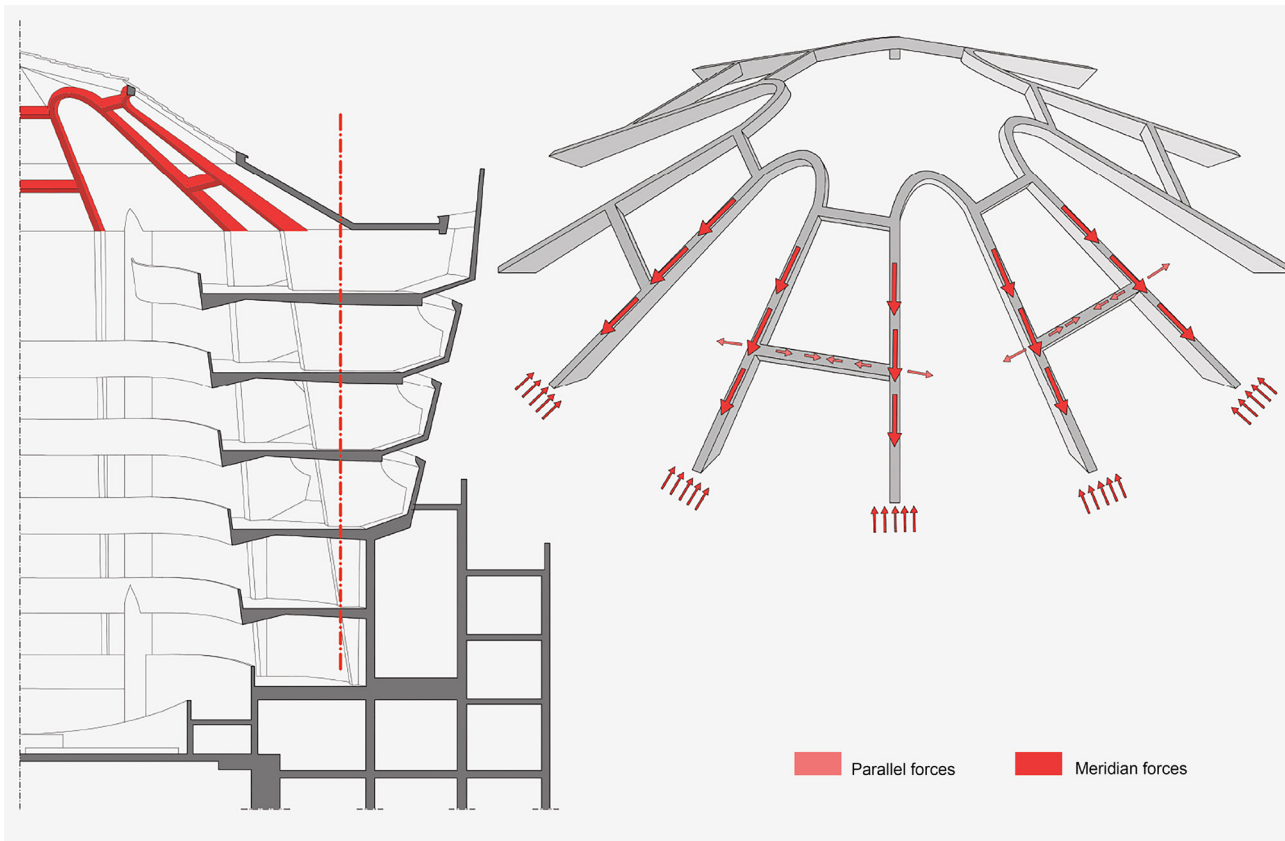
Fig. 9. Radial walls of the Archeseum: analysis of bending moments (graphic elaboration by the author).



wall, compared to that of the lower floors, caused by the changed conditions induced by the increase in the height of the floor, while the size of the corresponding internal overhang remained unchanged [Trombetti 2007, p. 58]. The last element to be analyzed not only in its static behavior but also in its relationship with the other components is what we have called a dome but which, as we have seen, corresponds to a glass pyramid with a dodecagonal base. The term dome is justified by its static functioning; in fact, the main framework of this element is made up of thin U-shaped beams, which extend from the sixth

level, projecting from the twelve radial partitions. These beams are responsible, just as happens with the ribs of a hemispherical vault, for transmitting the so-called meridian forces to the underlying structure, while the small horizontal beams that connect them counteract the parallel forces [Trombetti 2007, p. 60]. The roof, thus conceived, minimizes the load that the underlying structure must withstand, because it does not transmit any bending moment, since the insertion of a beam onto the triangular partition occurs in correspondence with the resultant of the vertical loads (fig. 10).

Fig. 10. Ribs of the Archeseum dome: analysis of meridian and parallel forces (graphic elaboration by the author).



Conclusion

Although brief, the structural analysis conducted here on the Archeseum reveals a profound interaction and collaboration between the architectural elements involved; it is almost as if the architect had wanted to adhere to the famous motto of *lieber Meister* Louis Sullivan: "Form

follows function" [Twombly 1988, p. 81]. Keeping in mind the organic direction taken by Wright's architecture, entirely permeated by the transcendentalist philosophy of Ralph W. Emerson e Henry D. Thoreau [Brunetti 1980, p. 102], it would be more correct to affirm that the 'soul' of the Guggenheim Museum precedes and holds together integrating them, idea, form and function.

Notes

[1] The name International Style comes from a book by Henry Russell Hitchcock e Philip Johnson, written for the International Exhibition of Modern Architecture. The exhibition, held at the MOMA in New York in 1932, promoted an architectural movement that had become established in the early 20th century. Some of the leading artists of the time, then residing in New York, including Rudolf Bauer and László Moholy-Nagy, supported the criticisms leveled by Frank Lloyd Wright's colleagues regarding the Guggenheim Museum project and attempted to negatively influence the opinion of the curator, Baroness Hilla Rebay, citing the unorthodox nature of the designer's

museography choices. In effect, the American architect was accused of wanting to build a monument to himself rather than a museum for the display of Mr. Guggenheim's non-objective paintings.

[2] Wright can be considered one of the pioneers –along with Louis Sullivan– and the greatest exponent of Organic Architecture, which aimed to achieve a balance between the built and natural environments. The precepts of this design approach, which some scholars have contrasted with Rationalism, were fully expressed in the lectures the American architect gave in London in 1939 [Wright 1939].

Author

Cosimo Monteleone, Department of Civil Environmental and Architectural Engineering, University of Padova, cosimo.monteleone@unipd.it

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