FRANK LLOYD WRIGHT AND THE MUSHROOM COLUMN

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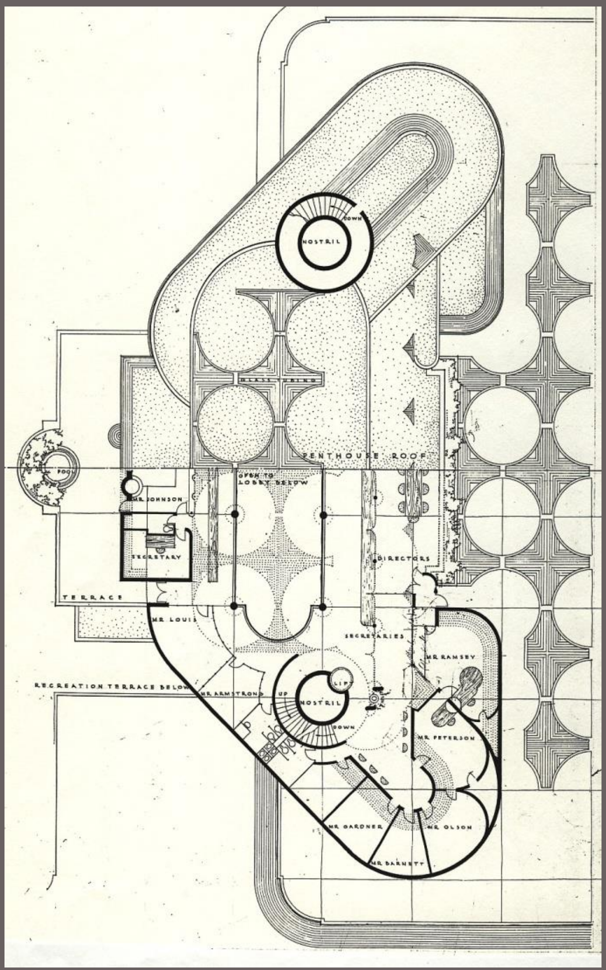
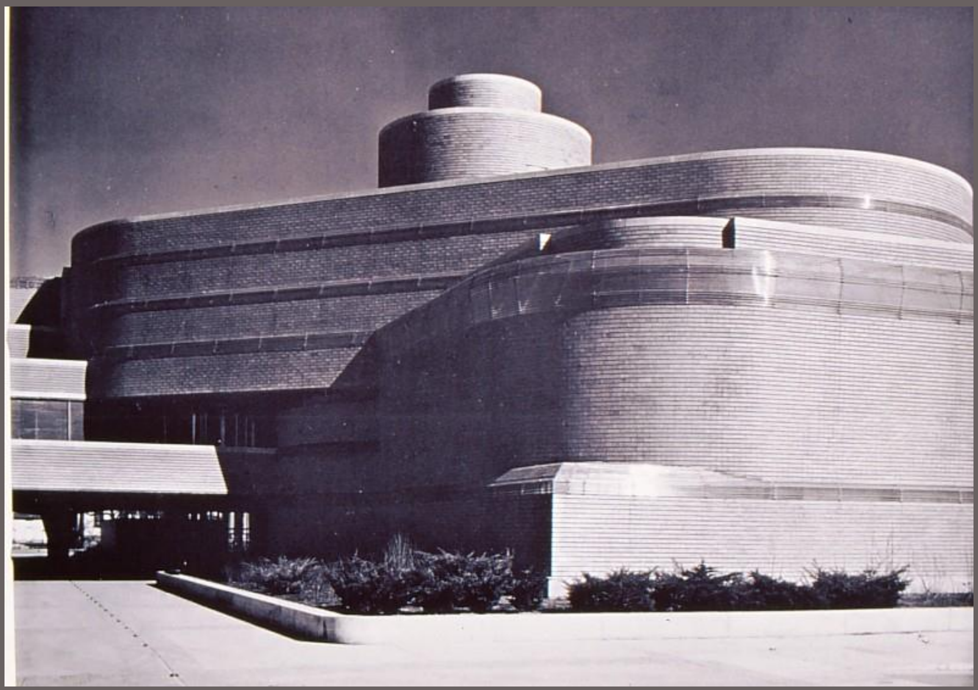
Located in Racine, Wisconsin, the **SC Johnson and Son Administration Building** is one of Frank Lloyd Wright's most important statements about the nature of **office buildings**. H.F. Johnson Jr. commissioned Wright to design a worldwide headquarters administration building for the family company and **in 1936** Wright's drawings were approved and the building officially opened in April of **1939**.

FLW’S MUSHROOM COLUMN





The upper floor plan (left) and the main entrance to the Administration building (right). The curved profile of the building is strenghtned by the horizontal rows of bricks and the window bands.

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The mortar in the flush, vertical joints was to be tinted almost the same color as the bricks, while the **continuous horizontal joints** were to be left **untinted** and raked deeply, leaving shadows running parallel to the ground.

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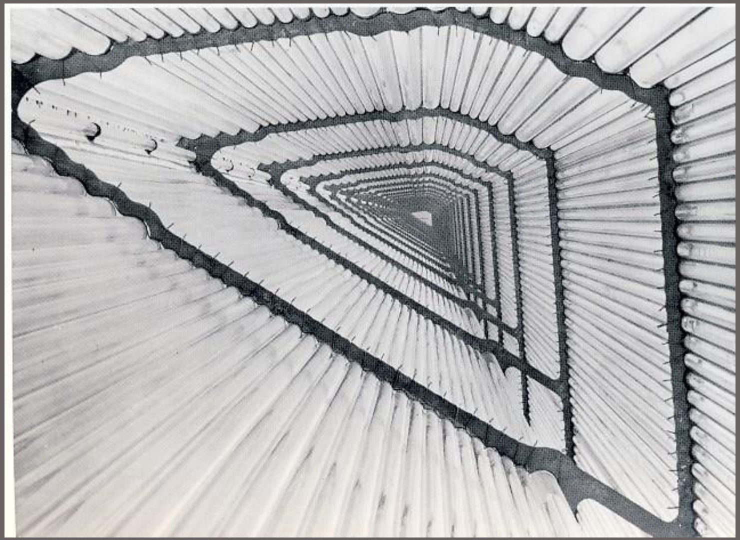
Equally innovative was the **Pyrex glass tubing** that formed the window bands around the Johnson's upper walls and, originally, the ceiling-roof area between the lily-pad capitals.



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The Johnson Wax headquarters day and night version: the window band becomes an iconic feature that highlights the dynamic shape of the building.

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Renzo Piano, Richard Rogers, Centre Pompidou Beauborg, Paris, 1971-1977

Frank Lloyd Wright, Johnson Wax Administration Building, 1936-39

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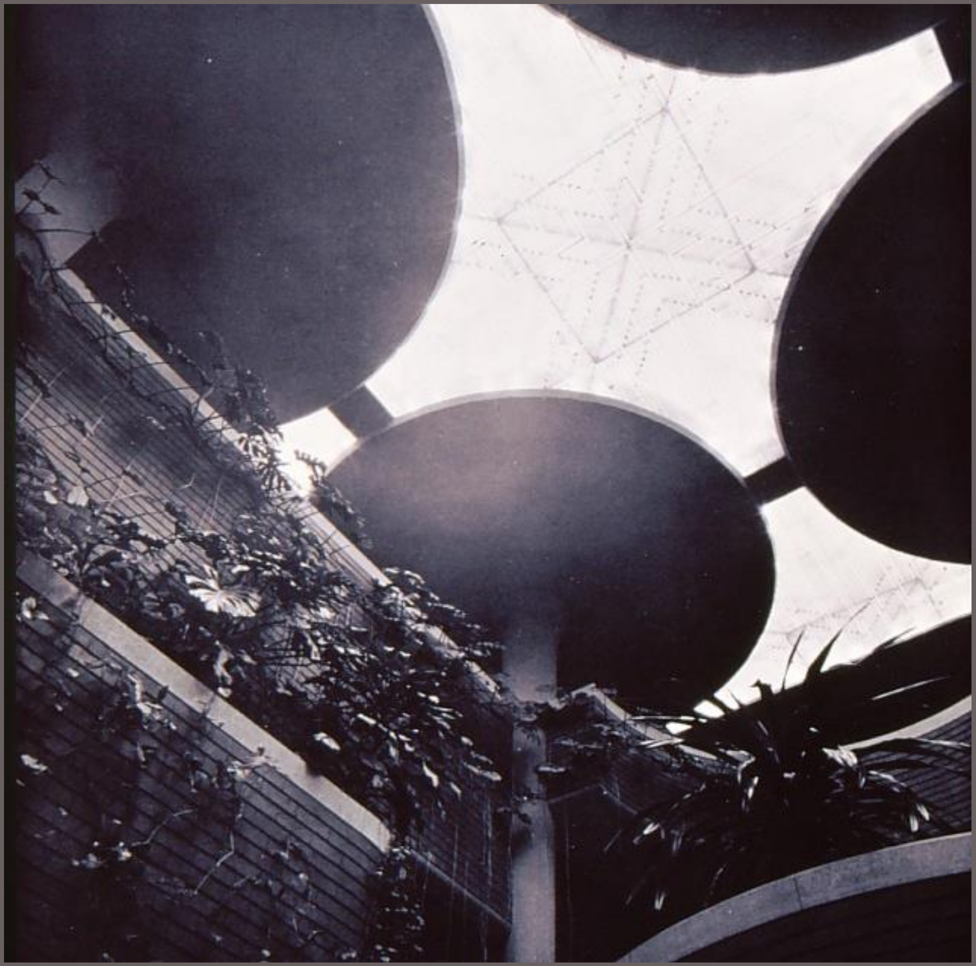

"I knew the scheme I wanted to try. I had it in mind ….**A great simplicity.**" (F.L.Wright). What the architect had in mind was the use on **dendriform columns**, rising from the base and spreading out in circular pads to the top.

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F.L.Wright, Johnson Wax Administration Building, the Entrance lobby (left) and the Great Workroom (right).

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Wright promised to give mr. Johnson a beautiful building in which a person could "**feel as though he were among pine trees breathing fresh air and sunlight**" In the Administration Building he created a private, air-conditioned working area nestled within a man-made forest.

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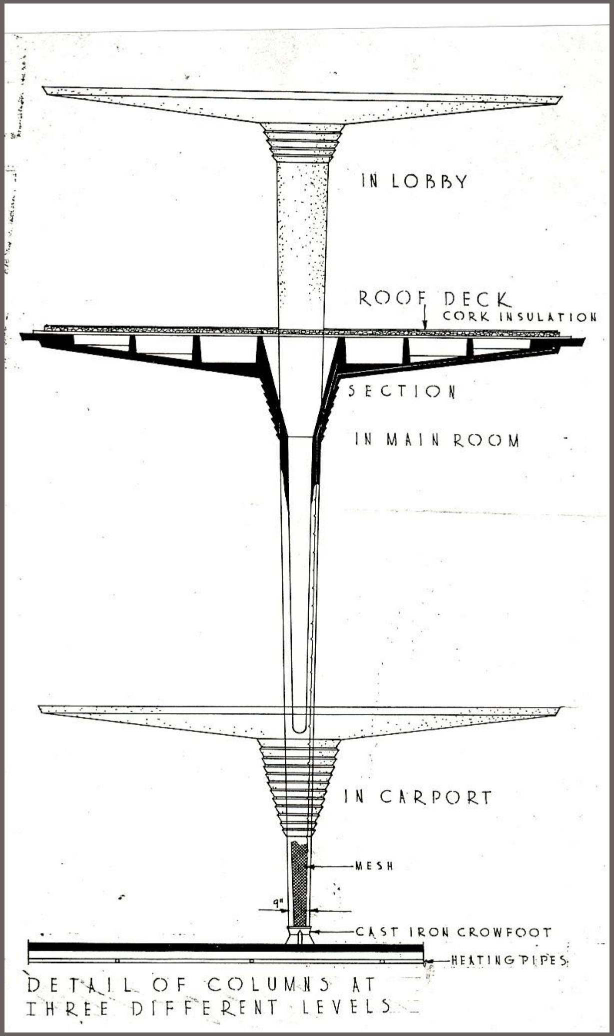

Wright called the columns **"dendriform" – tree shaped** – and he borrowed from botany to name three of their four segments, **stem, petal and calyx.** The base of each column is seven-inch-high, three ribbed shoe , which he called a **crow's foot**. On it rests the **shaft, or stem**, nine inches wide at the bottom and widening two and half degrees from the vertical axis. The taller columns are mostly hollow, the walls being only three and a half inches thick. Capping the stem is a wider hollow, ringed band, which Wright referred to as a **calyx**. On it sits a twelve-and-half-inch-thick hollow pad called the petal.

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The columns that Wright created for the Administration Building are structurally more efficient than their predecessors. The partially **hollow column stem** and the **hollow calyx and petal** are so thin that they are **virtually shell structures**, though they were designed before the term was invented. Wright was able to design such thin columnar elements by using unusually **high strength concrete**.

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All the circular slab on the petals are interconnected at the roof level by **short beams** , each slab providing partial support for the one adiacent to it.

The resulting absence of bending in the column makes possible the use of extremely narrow, virtually hinged bearing at the column foot.

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Multidirectional steel mesh, lighter and stronger than steel bars for resisting tensile stresses, was used as the reinforcing both columns and pads.

A giant saguaro (left) and a staghorn cholla (right).

To illustrate his choice for the steel of Johnson's columns, Wright pointed to two **cacti** nearby the desert, a **giant saguaro and a staghorn cholla**. A concrete column reinforced with steel rods might be likened to the giant saguaro, but a column reinforced with **a cylindrical basket of steel mesh** resembled the staghorn, the natural structure Wright followed in the Johnson Wax building.

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Although Johnson had a good relationship with the local officials, they were anxious about the engineering calculations made by Wright and his assistants, so that the building department demanded that the new column be tested with a load of 24.000 pounds, twice the full design load.

It was not only the column to be tested, but Wright's vision and the fate of project. Surrounded by a crowd of officials, reporters, clients and Taliesin workers, a crane dumped load after load of iron on the column..

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When the load finally reached the 24.000 pounds required, Wright insisted they keep going and see how far it could go before the point of destruction. At 60 tons, it was carrying five times the tests requirements and Wright ordered the supporting braces removed; the calyx of the column broke, but the column itself was still intact. He had proved his vision in practice and created a **new column for the twentieth century.**

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Swiss civil engineer, **Robert Maillart**, revolutionized the use of structural reinforced concrete with his designs for bridges and column design in a number of buildings.

His revolutionary **mushroom ceiling** was first constructed in the **Giesshubel warehouse** (1910), where several new designs were implemented. Instead of reinforcing the concrete floor with beams, Maillart treated it as a **flat slab** and shaped the column capitals in such a way that the forces would flow smoothly, providing an elegant and efficient shape.

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. The organic forms of the elements and their placement was developed geometrically and in keeping with the structures of the petals of **lotus blossom**.

Toyo Ito's design of the new **College of Social Sciences** for the **National Taiwan University (2006-2013)** has brought forth a building that is clearly subdivided according to functions.

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Taking three focal points as starting point, the density of columns decreases as one moves outward. The variety in the positioning of the columns gives the reading room its distinctive flair.

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Supporting the vertical load, the **reinforced-concrete columns** measure 10 inches in diameter and 20 feet in height, and are arranged using a **double-spiral algorithm**. Overhead, the columns culminate **in flared capitals** that spread like tree canopies. Though they invite comparison with the circular capitals in Frank Lloyd Wright's Johnson Wax Building, Ito's versions are **organically shaped** and positioned off-center in relation to the columns.

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SOM (Skidmore Owings and Merrill LLP), the new **Integrated Terminal Building at Mumbai's Chhatrapati Shivaji International Airport** (2014) combines international and domestic operations at one of India's busiest airports.

Designed to accommodate up to 40 million passengers per year, the 410,000-square-meter facility features a number of structural innovations.

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A key feature is a long-span roof covering 70,000 square meters, making it one of the world's largest roofs without an expansion joint.

The roof is supported by 30 massive columns spaced at 64 meters in the north–south direction and at 34 meters in the east–west direction. SOM increased the depth of the trusses near the columns, and ran trusses in both an orthogonal grid and a 45-degree grid, resulting in generous spacing and cantilevers of 40 meters along the perimeter.

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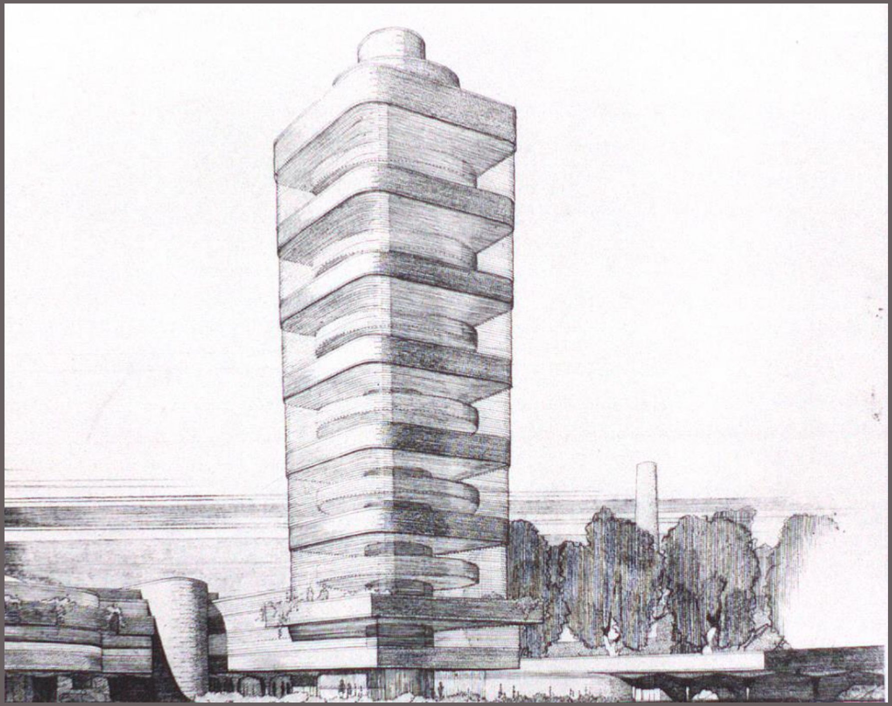
The monumental spaces created beneath the **thirty mushrooming columns** call to mind the **airy pavilions** and interior courtyards of **traditional regional architecture.**

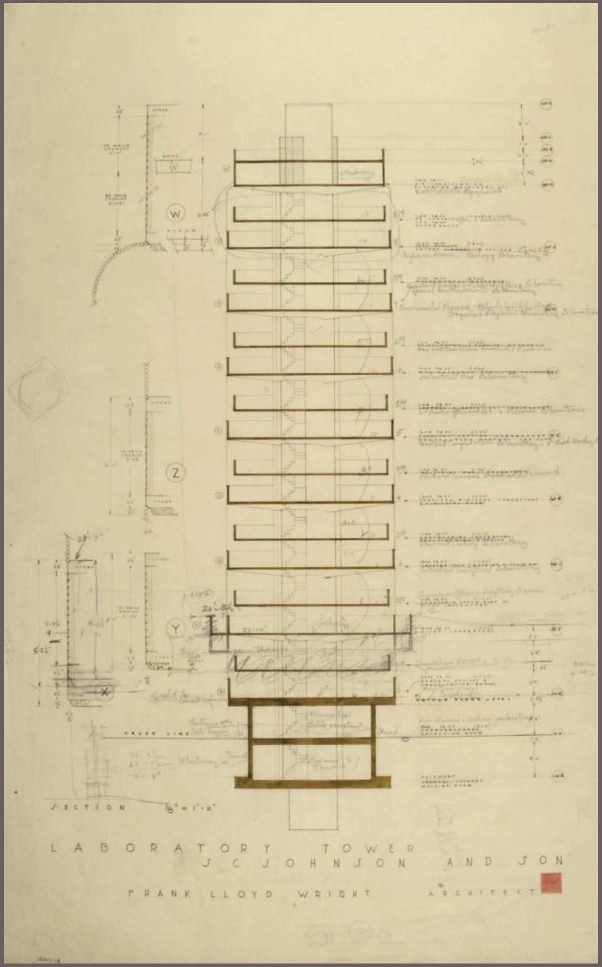
Small disks of colorful glass recessed within the canopy's coffers speckle the hall below with light. The constellation of colors makes reference to the **peacock**, the national bird of India, and the symbol of the airport.

FLW'S MUSHROOM COLUMN



In **1943** the head of the Johnson group began to correspond with Wright about the construction of a **research facility** adjacent to the Administration Building.

FLW’S MUSHROOM COLUMN



As shown in the section the tower’s floors cantilevered off its central shaft would expand on the idea of the lily-pad columns in the administration building.
The glass tubing would also follow from the earlier masterwork.

FLW'S MUSHROOM COLUMN

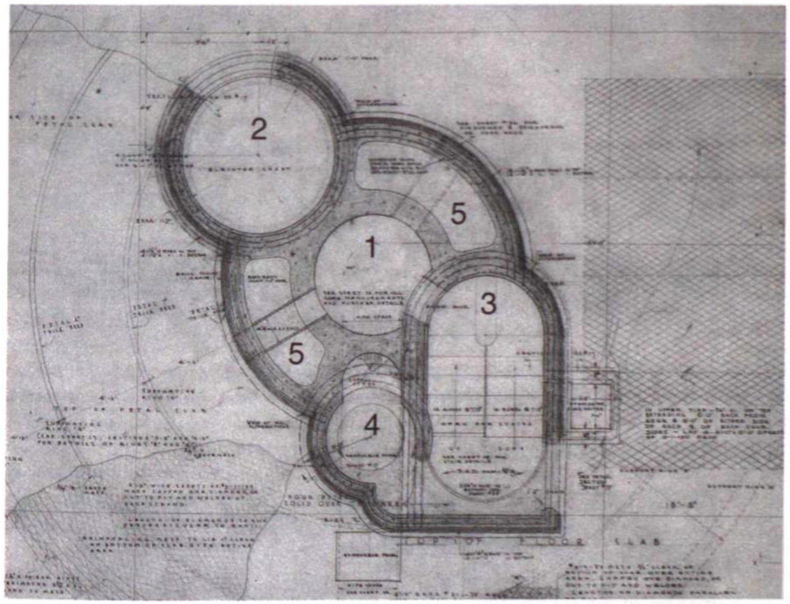


Figure 10. Research Tower, 1946. South, and the Administration Building, to the left, (1) supply; (2) elevator; (3) stairs; (4) toilet; (5) exhaust (FLWA, drawing no. 4401.066; (c) Frank Lloyd Wright Foundation; graphic additions by author)

A major part of this effort was the design of the tower's mechanical system to rise through its columnar shaft. These would include not only steam supply and return for heating , the direct and alternating electric current, and plumbing including hot and cold water, but also air conditioning ducts and illuminating gas, distilled water, carbon dioxide or nitrogen, and compressed air for laboratories. **This suggested the organic analogy of a building like a living form dependent on its internal flow of fluids.**

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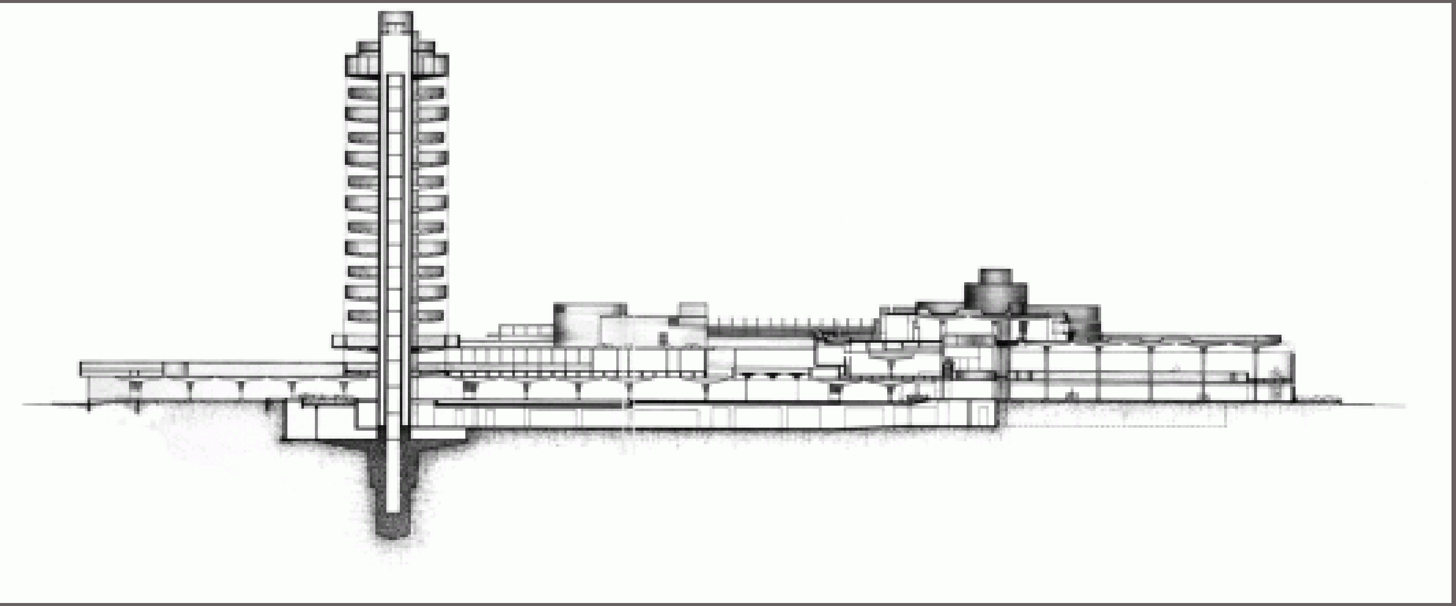

The Johnson's tower's section shows the only realized example of what Wright called a **taproot foundation** for its columnar shaft. The term denotes a very deep construction , analogous to the taproot as the exaggerated main root of certain plants in contrast to laterally spreading roots just below the ground.

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The tower was the first large cantilevered structure with a hollow concrete core to be constructed , providing the first practical test of Wright's structural ideal for the **multifunctional column** on a large scale.

Wright reinvented the idea of the **columnar shaft** to be at once a construction and a conduit on a large scale, as the core of a large cantilevered structure.