Case Study 12.5: The Einstein Tower, Potsdam, Germany

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Presentation and analysis of the site

Geographical position: Telegrafenberg 1, 14473 Potsdam, Germany.

Location: Latitude 52º 22´ 44˝ N, longitude 13º 3´ 50 E˝. Elevation 87m above mean sea level.

General description: The Einstein Tower, designed by the Berlin architect Erich Mendelsohn (1857–1953) and built in the early 1920s, is both an astrophysical observatory and a masterpiece of the history of modern architecture in Germany.

Brief inventory:

- The **tower** itself is 20m high. It was constructed between 1920 and 1922, but owing to a lack of modern construction materials after World War I, the tower had to be built with bricks instead of reinforced concrete. As a protection against the wind and heating, a wooden structure was added on the inside of the tower, and this supports the objective lens.
- The **instrumentation** was installed in 1924. The dome is 4.5 m in diameter and contained the two 85 cm-coelostat mirrors. The lens of 60 cm aperture and 14.50 m focal length produced a solar image 14 cm in diameter. The company Zeiss of Jena was responsible for the instrumentation.
- The **cellar** contained a room at constant temperature. Here, two high-resolution spectrographs produced solar spectra from red to violet with a length of 12 m. In 1925, a physical-spectrographic laboratory was constructed. This contained a spectral furnace as a comparison light source, an apparatus to produce an electric arc, a photoelectric Registration photometer, an electromagnet and an apparatus for the investigation of the hyperfine structure of emission lines. The instrumentation reached the highest technological standards found anywhere at the time.

History of the observatory: By the beginning of the 20th century, the USA had attained a strong position in the development of astronomy. In Germany, by comparison: there was too much emphasis on classical astronomy instead of modern astrophysics and solar physics; the astronomical instruments in most observatories were not up to date; the climatic conditions and seeing quality were no match for those in California; and there was no possibility of the levels of private financial sponsorship that could be sought in the USA. Yet there was a strong political will to promote science after World War I—the slogan ‘Science as substitute for political power’ was introduced—and in 1920 the “Notgemeinschaft der Deutschen Wissenschaft” (NDW) was founded, so that German science flourished in the 1920s despite the political and economic conditions.

The impulse for financing a German solar observatory arose from the spectacular result of the English eclipse expedition in October 1919, which confirmed Einstein’s general theory of relativity. Other attempts to do so having been unsuccessful, the idea was to measure the red shift of spectral lines in the gravitational field of the Sun with a new kind of solar telescope. In fact, this attempt failed too, because the effect on the redshift due to relativity is swamped by other, stronger effects present in the Sun; however, as a consequence of studying all these other effects, the Einstein Tower became the most important solar observatory in the world in the 1920s.

It was renamed in 1933, in the context of the political developments of the Nazi era, becoming the *Institute for Solar Physics*, but its significance only started to decline as new solar observatories started to be constructed in other countries in the late 1930s. In 1950 Harald von Klüber (1901–1978) succeeded in measuring the general magnetic field of the Sun using photographic methods in the Einstein tower.

Cultural and symbolic dimension of the site: Erwin Finlay-Freundlich (1885–1964), astronomer and architect, gave advice about the instrumentation and Mendelsohn, who was a personal friend of Freundlich's, was assigned the task of designing the tower. Mendelsohn became fascinated by Einstein's world of thought and this inspired him to produce novel architectural ideas. He was looking for new architectural forms of expression, which he wanted to achieve with modern materials such as steel and reinforced concrete, and he even designed the office furniture and fixtures. The resulting building, with its gently bulging shapes, is a perfect synthesis between dynamics and functionality and is widely recognised as one of the best examples of explorations in constructivist and expressionist architecture during the 1920s in Central Europe.

As Freundlich himself opined:

> "The design of the telescope as a tower telescope gave the Einstein Tower its special character and allowed the architect to allocate the building the character of a monu ment due to the epochal significance of the theory of relativity in the development of physics."[1]

The building design is dynamic, using curved lines and window openings to play around with the verticality of the solar instrument, while the horizontal annexes are softly linked with the surrounding ground surface. It is like a monumental coating—a sort of sculptural/architectural dressing—on the machine. The interior of the tower gives the feeling of a putting the scientific devices 'on stage', establishing a deep resonance between modern architecture and cutting-edge science. The Einstein Tower is a remarkable example of osmosis between two very different fields of research—structural design on the one hand and astrophysics on the other. It elegantly expresses human hopes for scientific progress in harmony with the cultural values of society.

Comparative analysis: In the 1920s several further solar towers were built, but they mostly had a 30cm aperture; none surpassed the Einstein Tower. The full list is as follows:

Observatory	Year	Aperture	Focal length	Solar image
Mount Wilson 18m	1907	30cm	18m	5–17cm
Mount Wilson 50m	1912	30cm	46m	5–43cm
Utrecht	1922	25cm	13m	7–17cm
Potsdam	1922–24	60cm	15m	14–25cm
Arcetri	1926	30cm	18m	17cm
Pasadena	1926	30cm	5.5m	5–42cm
Tokyo	1928	45cm	15m	14–25cm
Canberra, Australia	1924–50	30cm	13m	12cm

[1] Finlay-Freundlich, Erwin, "Wie es dazu kam, daß ich den Einstein-Turm errichtete", *Physikalische Blätter* 25 (1969), 538–541, p. 541.

Fig. 12.5.1. The Einstein Tower (1924) is an astrophysical observatory and also a masterpiece of the history of German architecture designed by Erich Mendelsohn (1857-1953). Photograph © R. Arlt.

In terms of architecture, the 19th century and modern period had produced observatories that were neo-classical monuments, frequently repeating the same shape and decorative patterns as civil palaces. The only specific feature of the observatory remained the 'dome', conceived generally as an associated device for the telescope. In term of design, the dome was frequently a pure hemisphere or something close to it, clearly separated from the vertical walls of annexes. At the Einstein Tower, the dome is completely integrated into the whole structure, and its curves are also present and repeated in the overall shape of the monument.

The Einstein Tower is arguably a rare, and perhaps unique, example of a real creative effort in observatory design, directly related to a new structural style, by a major architect of the time. It brilliantly brings together different sources of creativity and innovation.

Present site management

Present use: The Einstein Tower is still active as a solar observatory.

Protection: The building is under monument protection.

State of conservation: The tower has been restored many times during past decades; a very careful restoration (costing three million euros) was carried out between 1997 and 1999, financed jointly by a private grant and the Astrophysical Institute Potsdam.

Context and environment: The tower is located in the *Wissenschaftspark Albert Einstein*.

Management: The Einstein Tower belongs to the Astrophysical Institute Potsdam.

Additional bibliography

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