Leaning Tower of Pisa

The Leaning Tower of Pisa (Italian: torre pendente di Pisa [ˈtorre penˈdɛnte di ˈpiːza, -ˈpiːsa][1]), or simply the Tower of Pisa (torre di Pisa), is the campanile, or freestanding bell tower, of Pisa Cathedral. It is known for its nearly four-degree lean, the result of an unstable foundation. The tower is one of three structures in the Pisa's Cathedral Square (Piazza del Duomo), which includes the cathedral and Pisa Baptistry

The height of the tower is 55.86 metres (183 feet 3 inches) from the ground on the low side and 56.67 m (185 ft 11 in) on the high side. The width of the walls at the base is 2.44 m (8 ft 0 in). Its weight is estimated at 14,500 tonnes (16,000 short tons).[2] The tower has 296 or 294 steps; the seventh floor has two fewer steps on the north-facing staircase.

ARCHITECT OF LEANING TOWER OF PISA

Architect

The identity of the architect of the tower is a subject of controversy. The design had long been attributed to a man named Guglielmo and to Bonanno Pisano, the latter a well-known 12th-century resident artist of Pisa known for his bronze casting, particularly in the Pisa Duomo.[7][better source needed] Pisano left Pisa in 1185 for Monreale, Sicily, only to return and die in his home town. A piece of cast bearing his name was discovered at the foot of the tower in 1820, but this may be related to the bronze door in the façade of the cathedral that was destroyed in 1595. A 2001 study seems to indicate Diotisalvi was the original architect, due

to the time of construction and affinity with other Diotisalvi works, notably the bell tower of San Nicola and the Baptistery, both in Pisa.[8][page needed]

Construction

Construction of the tower occurred in three stages over 199 years. On 5 January 1172, Donna Berta di Bernardo, a widow and resident of the house of dell'Opera di Santa Maria, bequeathed sixty soldi to the Opera Campanilis petrarum Sancte Marie. The sum was then used toward the purchase of a few stones which still form the base of the bell tower.[9] On 9 August 1173, the foundations of the tower were laid.[10] Work on the ground floor of the white marble campanile began on 14 August of the same year during a period of military success and prosperity. This ground floor is a blind arcade articulated by engaged columns with classical Corinthian capitals.[11] Nearly four centuries later Giorgio Vasari wrote: "Guglielmo, according to what is being said, in the year 1174, together with sculptor Bonanno, laid the foundations of the bell tower of the cathedral in Pisa".[12]

The tower began to sink after construction had progressed to the second floor in 1178. This was due to a mere three-metre foundation, set in weak, unstable subsoil, a design that was flawed from the beginning. Construction was subsequently halted for the better part of a century, as the Republic of Pisa was almost continually engaged in battles with Genoa, Lucca, and Florence. This allowed time for the underlying soil to settle. Otherwise, the tower would almost certainly have toppled.[13] On 27 December 1233, the worker Benenato, son of Gerardo Bottici, oversaw the continuation of the tower's construction.[14]

On 23 February 1260, Guido Speziale, son of Giovanni Pisano, was elected to oversee the building of the tower.[15] On 12 April 1264, the master builder Giovanni di Simone, architect of the Camposanto, and 23 workers went to the mountains close to Pisa to cut marble. The cut stones were given to Rainaldo Speziale, worker of St. Francesco.[16] In 1272, construction resumed under Di Simone. In an effort to compensate for the tilt, the engineers built upper floors with one side taller than the other. Because of this, the tower is curved.[17] Construction was halted again in 1284 when the Pisans were defeated by the Genoese in the Battle of Meloria.[10][18]

HISTORY FOLLOWING CONSTRUCTION

History

Between 1589 and 1592,[22] Galileo Galilei, who lived in Pisa at the time, is said to have dropped two cannonballs of different masses from the tower to demonstrate that their speed of descent was independent of their mass, in keeping with the law of free fall. The primary source for this is the biography Racconto istorico della vita di Galileo Galilei (Historical Account

of the Life of Galileo Galilei), written by Galileo's pupil and secretary Vincenzo Viviani in 1654, but only published in 1717, long after his death.[23][24]

During World War II, the Allies suspected that the Germans were using the tower as an observation post. Leon Weckstein, a U.S. Army sergeant sent to confirm the presence of German troops in the tower, was impressed by the beauty of the cathedral and its campanile, and thus refrained from ordering an artillery strike, sparing it from destruction.[25][26]

Numerous efforts have been made to restore the tower to a vertical orientation or at least keep it from falling over. Most of these efforts failed; some worsened the tilt. On 27 February 1964, the government of Italy requested aid in preventing the tower from toppling. It was, however, considered important to retain the current tilt, due to the role that this element played in promoting the tourism industry of Pisa.[27]

Starting in 1993, 870 tonnes of lead counterweights were added, which straightened the tower slightly.[28]

EARTHQUAKE SURVIVAL

Survival

The tower has survived at least four strong earthquakes since 1280. A 2018 engineering investigation concluded that the tower withstood the tremors because of dynamic soil-structure interaction: the height and stiffness of the tower combined with the softness of the foundation soil influences the tower's vibrational characteristics in such a way that it does not resonate with earthquake ground motion. The same soft soil that caused the leaning and brought the tower to the verge of collapse helped it survive.[38]