**Leaning Tower of Pisa**

The tower in Pisa, Italy, is famous simply because it leans. It was closed to the public in 1990, after fears that an entire busload of tourists at the top would be enough to make it fall. Eleven years later, the lean has been corrected a little, but not entirely.

Although the tower is famous because it leans, it is an outstanding example of Romanesque architecture, and would probably be famous, even if it didn't lean. It stands 187 feet high and until 1990 was leaning over at about a 10-degree angle, the top being 17 feet further over than was originally intended. It was estimated that the lean was increasing by one inch every 20 years.

Construction

In 1172, a wealthy widow named Berta di Bernado, left sixty coins in her will to buy stones to begin the construction of the tower. It is a bell tower to accompany the cathedral that it stands next to. It isn't quite clear who the actual designer was, but construction was begun on August 9, 1173. Due to the fact that the people of Pisa were involved in a lot of wars, with several stops to fight, it took until 1350 to complete the building.

The tower is circular, and made up of eight floors of limestone and lime mortar, covered on the outside with marble. The outside of each level has columns and arches. There is a staircase of 293 steps leading up from the ground to the eighth floor; the steps are built between an inner wall and the outer walls. The eighth floor contains the bells, seven in all.

The first stage was the building of the first three floors; this began in 1173 and stopped in 1178, when Pisa was at war. Construction began again in 1275 under an architect called Giovanni di Simone. He built the next three floors, and again work was halted until 1319. The final two floors were added between 1319 and 1350.

The Lean

Only 5 years after work on the building began, it was leaning noticeably to the North. The lean was first noticed during construction of the third floor. During the building of the next three floors, the lean was corrected by building the floors parallel to the ground, and not level with the leaning building. During this phase the tower started to lean the other way. Now it was leaning to the South.

Why the lean?

The tower is built on unsuitable ground for such a heavy and tall building. It is only about 6 feet above sea level and built on a riverbed. The underlying ground is made up of layers of sand and clay. The layers are not even and the weight of the building has compressed them. Because the layers are not even, as the ground has compressed, it has sunk more in some places than others.

Why hasn't it fallen over?

The fact that it took such a long time to build may be the main reason it hasn't fallen. Between the periods of construction the ground had time to settle and become compacted, making the foundations stronger. Another important factor is the material it is built from; the limestone and lime mortar are able to bend and resist the forces that would make other, more brittle rocks, crack.

Why won't it fall in the future?

Several plans have been tried over the years to stop the tower from falling. Some of them have been almost disastrous. In 1934 an Italian engineer drilled 361 holes into the base and filled them with mortar. The tower promptly leaned over some more. In 1993 650 tons of lead were hung from the North side of the building to try and stop the lean increasing. For a while it worked.

In 1995, they decided to try and increase the foundations under the South side of the building. They froze the ground using liquid nitrogen, to stop it moving, and then started to remove stones, so they could insert metal rods. What they didn't know was that the stones they were removing were part of the original foundation of the building. That is the nearest the tower has come to disaster. In one night the lean increased as much as it normally increases in two years. They quickly added another 250 tons of lead and decided to rethink the whole thing.

At this point everyone was just about ready to give up. Then a British engineering professor came up with yet another idea. His plan was to remove ground from under the high side, instead of trying to add ground under the low side. In 1999 work began, and was done very slowly, so that the building wouldn't get a sudden shock. At the beginning of June 2001, the work was complete, and the tower had been straightened up by about 16 inches, which returns it to the position it held in 1838. The engineers believe that it is safe for at least another 300 years.

So, if they know how, why didn't they just straighten it up all the way? The answer lies in the tower's name. It is the Leaning Tower of Pisa and just wouldn't be the same if it didn't lean! Some of the residents of Pisa say it would be better to let it fall down, rather than to straighten it all the way.

<http://www.travel-to-tuscany.org/leaning-tower-of-pisa.html>