Burland's efforts to save the Leaning Tower of Pisa

John Burland believes that stabilization of the 630-year old Leaning Tower of Pisa represents the ultimate civil engineering challenge.

"Imagine a tower built on ground that has the consistency of jelly or foam rubber to any great depth. The inclination of the tower is increasing to a point where it is about to fall over and any disturbance to the ground on the leaning side will cause it to topple," said Dr. Burland who is a professor of soil mechanics at the Imperial College of Science, Technology and Medicine in London.

"Worse yet, the material composing the tower is so fragile that the stresses caused by its lean are close to causing structural failure," added Dr. Burland, whose research focuses on a wide spectrum of geotechnical problems ranging from the fundamental mechanical properties of soils to practical issues relating to such matters as foundation design and construction, deep excavations, slope stability and the interactions between the ground and structures founded on or in it.

Dr. Burland believes that the impending instability of the Tower foundation is not due to a shear failure of the ground, but can be attributed to the high compressibility of the Pancone Clay.

"This phenomenon is called leaning instability. No matter how carefully the structure is built, once it reaches a critical height the smallest perturbation will induce leaning instability." said Dr. Burland. "Children building brick towers on a soft carpet will be familiar with this phenomenon!"

Dr. Burland has worked on the tower since 1990 as a member of the Italian Prime Minister's Commission to stabilize the Tower. His team implemented temporary stabilization methods that included addressing the masonry problems by binding lightly prestressed plastic covered steel tendons around the Tower. This closed some of the cracks and reduced the risk of buckling in the marble cladding.

Also, temporary applications of 600 tons of lead weights to the north side of the foundation improved the stability of the foundation.

Several times during the next few years soil extraction methods were discussed.

Dr. Burland explained the theory behind the soil extraction method.

"This will cause the high side to gently subside and the inclination of the tower to reduce by a controlled amount," said Dr. Burland. "The 'out of plumb' is to be reduced from 4.5 meters to 4.0 meters, which will not be visible to tourists, but will stabilize the Tower."

Preliminary soil extraction has produced a positive response and the Commission has formally approved the application of the method for permanent stabilization.

"Using 41 extraction tubes, work on the full intervention started at the end of February 2000. It is estimated that it will take about two years of careful soil extraction to reduce the inclination of the Tower by about half a degree, which will be barely visible," explained Dr. Burland.

Since the end of February, the inclination of the tower has decreased by one quarter of the target value of 0.5 meters—125 millimeters.

"After 10 years of work the first positive steps have been taken but there is a long tense journey still ahead of the Tower," said Dr. Burland.

Other projects that Dr. Burland has been involved in include design of the underground car park at the Palace of Westminster in London and he served on the international board of consultants on the stabilization of the Metropolitan Cathedral in Mexico City. More recently he consulted on the Jubilee Line Extension underground railway and the protection of many historic buildings from damage due to subsidence.