

A Hinge to Safeguard the Leaning Tower

This study examines a technique for restoring stability to the Tower of Pisa. It is based on a continuous hinge that is able to decrease the present inclination or, if required, to confer verticality to the building.

The operation consists of laying, into a portion of soil underlying the Tower, a series of devices placed in the north-south direction and linked together in the east-west direction. Each of these devices consists of two steel plates, of which the lower one is stationary and horizontal and the other is inclined with respect to the former. They are hinged together in correspondence with the south extremity.

The activation of a previously installed hydraulic jacks complex, which is an integral part of the system, allows this set of devices to rotate the building very slowly in the vertical plane and in a counter-inclination of between $5^{\circ}30'$ and 0° .

The Tower and underlying soil are subjected to a horizontal displacement and the soil excavation to the south of the building does not further compromise the stability of the Tower, because the tangential component of the total load (building weight + underlying soil weight) is balanced by both the friction resistance existing between the Tower-underlying soil complex and the sliding surface and by the resistance to the shearing stress of the anchoring bolts, which link the movable plate to the previously reinforced soil underlying the building.

Once the gradual decrease in the actual inclination has been achieved, the operation is concluded by progressively and systematically replacing the jacks by the same number of fixed bearings, and by laying a sub-foundation that can ensure good interaction between the building and the soil in a permanent manner.

The proposed technique is essentially very simple, but its application is extremely delicate. It could be the definitive solution to a problem that has always existed and that has not yet been solved.