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ABSTRACT

The Sacred Heart church of Vistabella (La Secuita, Tarragona) was designed by Josep Maria Jujol, one of the masters of Catalan Modernism, and built in the early twenties of the XX century. The slenderness of its tower makes it extremely exposed to wind action, to the extent that its stability has been threatened since its construction started. The structure of the steeple consists of four inclined T-shaped masonry ribs, crowned by a cross. Two intermediate levels sustained in short and shallow masonry arches, act as a bracing systems. At the end of 1934, the upper spire crumbled away, being rebuilt and reinforced with a pair of steel passive bars per rib.

After some numerical approaches, it became clear that the lightness of such a masonry construction along with the feebleness of the connections between the structural members were at the basis of the problem.

In order to provide additional vertical load without substantively modifying the structural scheme, a solution based on external prestressed bars, has been implemented. They replace the existing passive bars, which have proven to be totally useless. The proposed active system aims to eliminate tensile stresses from masonry.

Hence, eight steel bars (ties) have been placed where previously the steel passive bars were. By prestressing them, a permanent vertical loading will be introduced in the structure, improving its structural behaviour in front of the horizontal loads (wind action). The additional loading to be applied varies depending on the level (three levels in total). Therefore, it has been necessary to design a procedure able to introduce independent stresses at the different levels throughout the same tie.

Moreover, the prestressing process had to balance two different requirements: on one hand, the need to add load to the structure, and on the other - due to the slenderness of the masonry ribs - do not exceed the allowable compression stress of the material.

For this reason, 24 strain gages - 8 per level - have been placed along the steel bars, to individually control the stresses at any bar and level, by means of monitoring them. The ties have been prestressed from their lower end. Whenever all bars of a certain level reached the design value, they have been attached to the bracing system situated underneath.

It has been necessary to adjust the system since the stiffness of the bracing system wasn’t enough to prevent the transmission of load above those points that were considered already stabilized. After adjusting the procedure to take in to account such a situation, the structure has been artificially loaded until reaching the design values.

The procedure, the theory that supports it, and the results of the follow-up are described in detail.