Settlement induced damage modelling of historical buildings: the bell tower of the "Basilica dei Frari" in Venice

Claudio Modena[*], Maria Rosa Valluzzi[*], Filippo Lorenzoni[*], Filippo Casarin[*],

* Department of Structural and Transportation Engineering (DCT)
University of Padova, Via Marzolo, 9 – 35131 – Padova, Italy

Contact: Filippo Lorenzoni
e-mail: lorenzoni@dic.unipd.it
telephone: +39 049 827 5625 - +39 333 1919521
fax: +39 049 827 5613

Abstract

The presentation is about the case study of the "Basilica dei Frari" in Venice for which a non linear numerical analysis by means of DIANA finite element program has been recently performed in order to assess its structural conditions. In fact, from the end of its construction, in the XIV century, the building suffered from structural deteriorations mainly due to settlements affecting the bell-tower. A main structural intervention was carried out at the beginning of the XX c., aimed at stopping the outward tilting process of the tower. The intervention was so effective that it induced an opposite effect on the tower, which started to rotate towards the cathedral.

Several studies were carried out since then to evaluate the interaction between tower and cathedral, including in recent years structural monitoring and numerical modelling, besides a strengthening interventions consisting in soil microfracturing. A non linear numerical model of the church-tower complex was tuned on the outcomes of the experimental available data, also considering the historical process leading to the present day conditions. To gain reliable settlement damage predictions it was necessary to adopt tensile-softening crack models in the numerical studies and perform non linear analyses able to trace the complete response of the structure. The aim of the modeling was also, besides the assessment of the structural conditions of the complex, to predict the structural effects of the physical "separation" between tower and cathedral, intervention effectively carried out at the end of 2008.