

One-year static monitoring of the Milan Cathedral

Antonella Saisi*¹, Antonello Ruccolo*² and Carmelo Gentile*³

* Department of Architecture, Built environment and Construction engineering (DABC)

Politecnico di Milano, Milan, Italy

Piazza Leonardo da Vinci, 32 - 20133 Milan, Italy

¹ e-mail: antonella.saisi@polimi.it

² e-mail: antonello.ruccolo@polimi.it

³ e-mail: carmelo.gentile@polimi.it

ABSTRACT

The Milan Cathedral, built between 1386 and 1813 [1], is one of the largest masonry monuments ever built. Within the traditional collaboration between Politecnico di Milano and *Veneranda Fabbrica del Duomo di Milano* – the historic Institution established in 1387 and responsible for the preservation and development of the Cathedral – a structural monitoring system was recently designed and implemented [2] with the two-fold objective of assisting the condition-based structural maintenance of the Cathedral and creating a large archive of experimental data, useful to improve the knowledge of the monument.

The new monitoring system, fully computer based and with efficient transmission of the collected data, includes static and dynamic measurements. The static monitoring system consists of: (a) bi-axial tilt-meters installed at the top of selected piers and at 3 levels of the Main Spire; (b) vibrating wire extensometers mounted on the iron tie-rods which are characterized by the higher tensile stress; (c) temperature and humidity sensors for the measurement of internal and external environmental parameters. The dynamic monitoring is performed through seismometers (electro-dynamic velocity sensors) installed at the top of 14 selected piers and at 3 levels of the main spire.

After a concise historic background on the Milan Cathedral and the description of the sensing devices installed in the church, the paper focuses on the results obtained during the first year of static monitoring (since October 16th, 2018) and the lessons learned in view of the Structural Health Monitoring (SHM) of the monument. In more details, the time evolution of the different measured features (tilt and strain) is presented and discussed, along with the correlation between those features and the environmental parameters and the possible minimization/removal of the environmental effects with SHM purposes.

REFERENCES

- [1] Veneranda Fabbrica del Duomo, *Annali della Fabbrica del Duomo di Milano. Dall'origine fino al presente* (in Italian), Milan, 1885.
- [2] F. Canali and C. Gentile, "Continuous monitoring the cathedral of Milan: documentary and preliminary investigations", in: Proceedings of 10th Int. Masonry Conf. (10th IMC), Milan, pp. 2061-2072, (2018).