

Chapter 43

Seismic Assessment via EC8 of Modern Heritage Structures: Knowledge of the Structure and Analysis Methodologies

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ABSTRACT

Given the interest earned recently by modern heritage structures, seismic assessment criteria of Eurocode 8, for ordinary reinforced concrete structures, are applied to a modern heritage RC building. The case study, the Tower of the Nations in Naples, allows a discussion on knowledge approaches, analysis methodologies and modeling choices that can be considered. Modal dynamic identification, in situ inspections, and testing provided the necessary knowledge of the structure. Linear and nonlinear models of the structure are built up accounting for tuff infills' stiffness and strength contribution. Numerical modal properties are compared with those obtained through dynamic identification. Lumped plasticity model for reinforced concrete elements and equivalent strut macro models for tuff and concrete infills are employed for the nonlinear model of the structure. Seismic assessment through nonlinear dynamic analyses is carried out for two Limit States. Finally, fragility curves through cloud analysis are obtained for the different limit states considered.

DOI: 10.4018/978-1-4666-9619-8.ch043

INTRODUCTION

The Tower of the Nations is a modern heritage structure, located within the Mostra d'Oltremare urban park in Naples (Siola, 1990). The whole urban park was nominated in 2005 for the inscription in the UNESCO Modern Heritage List (<http://whc.unesco.org/en/events/247/>), given its relevant expression of the cultural and technical background at the time of design and construction. The Tower of the Nations was designed in 1938 by the architect Venturino Ventura, with the help of Carlo Cestelli Guidi (one of the most important structural engineers at the time) and of Guido Quaroni (architect and painter). The building was completed in 1940. The Tower has two glazed façades without any masonry infill (Figure 1a), and it has the other two façades fully infilled by tuff masonry, covered by white travertine plates, see Figure 1b. In 1940, the building had a basement decorated with low reliefs and a big statue representing the Fascist Victory (see Figure 1b); the provisional chalk version of the low reliefs was destroyed during the Second World War.

In the years following its construction, the structure was left to the carelessness. Recently the Tower has been included in a refurbishing project of the entire Mostra d'Oltremare urban park. The project includes the assessment and retrofitting of the Tower.

An example of Eurocode 8 (EC8) based assessment (CEN, 2005) carried out for this modern heritage reinforced concrete (RC) building is herein provided. Notwithstanding the fact that general assessment principles for ordinary RC structures can be easily applied to modern heritage buildings; this kind of buildings can often require specific approaches for structural knowledge, significant modeling efforts, and accurate analysis methodologies.

Therefore, all the assessment steps are reviewed considering the Tower of the Nation as test-bed. Structural knowledge (geometry, details, and materials), dynamic identification, choice of the structural analysis methodology are considered, and specific choices made for the assessment of this modern heritage structure are described. In particular, knowledge of the structure and dynamic identification phases emphasize the role that infills can play in the structural behavior of the building. Thus, infill structural contribution is included in the linear and nonlinear numerical model of the structure. While in the case of ordinary structures the explicit modeling of infill is a best-practice option, in the case of modern heritage it can be a key issue to capture modal properties and to model nonlinear behavior. Finally, the choice of nonlinear dynamic analysis as analysis methodology for EC8 based assessment allows also carrying out fragility curves for the limit states considered. On the

Figure 1. Mostra d'Oltremare complex (a), Tower of the Nations (b)



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