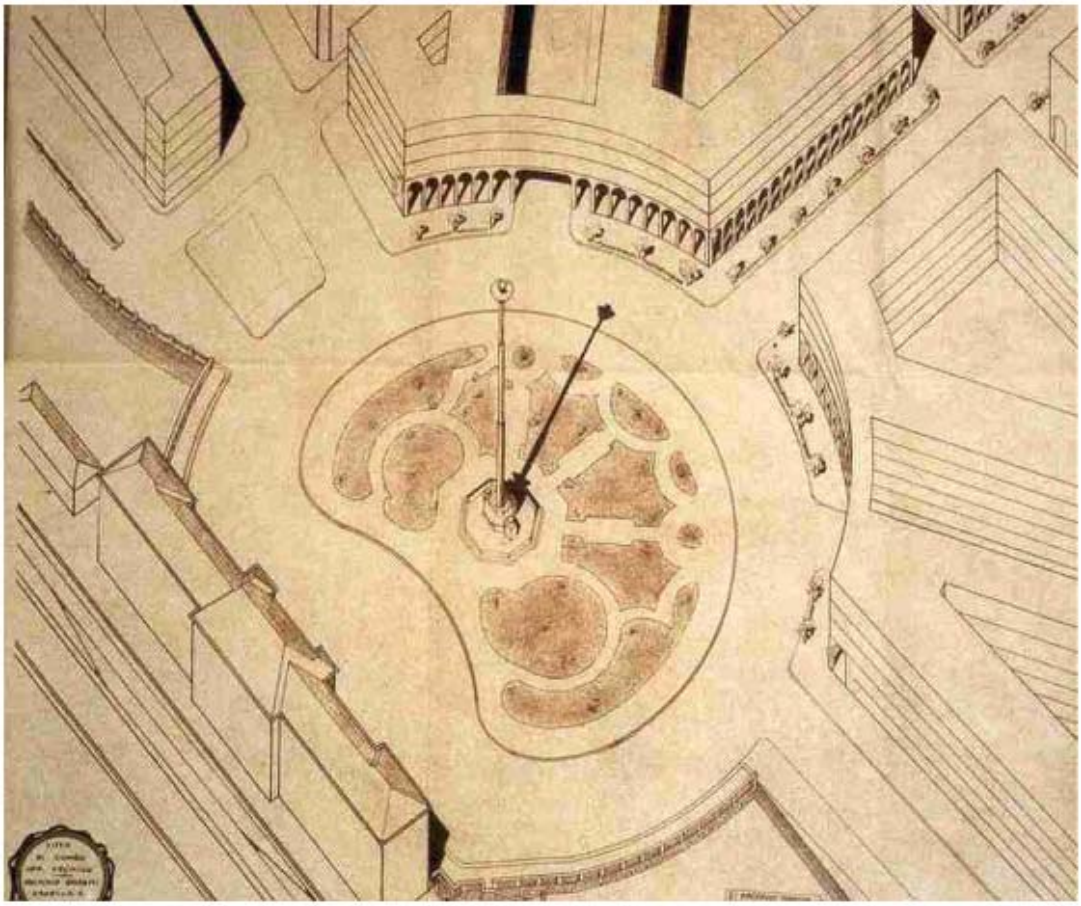
POLYTECHNIC OF TORINO
FACULTY OF ARCHITECTURE
Degree in Architecture
Honors theses

The "Lighthouse" of Cuneo: history and structure
by De Secondi Roberto and Zunino Raffaella
Tutor: Clara Bertolini Cestari
Co-tutor: Roberto Roccati

The present research examines the static and dynamic performances of a rather slender tower which was built in reinforced concrete in 1937 in order to illuminate the square in front of the Cuneo railway station.



The square

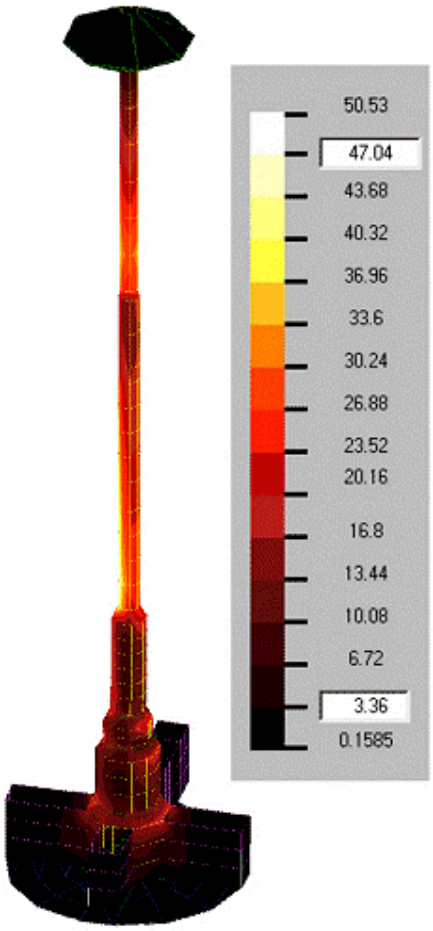
Thanks to a close analysis of many documents, it was possible to get the information concerning the theories and methods of calculation, as well as the materials mainly used during that period. The tower was designed by engineer Cesare Vinaj while the structural design was done by engineer Remo Locchi. The method "Mohr-Guidi", introduced in 1906 at the Polytechnic of Turin by Professor C. Guidi, was applied in order to calculate the neutral axis for the control of the different sections.

The realisation of the tower should be looked at as a product of the polytechnic culture and one should take into consideration the theoretical and project aspects of reinforced concrete. When the single designer planned his work on his own, he had to evaluate all the project, structural and technical aspects.

This study has also provided a structural analysis that has allowed us to evaluate the static and dynamic performances of the tower by carrying out numerical models of tridimensional and unifilar type through the use of calculation codes to finite elements. Furthermore, the unifilar model has been used into the dynamic field for the modal analysis that has enabled us to get the frequencies and the natural period oscillation. Since the period is fixed in 2.87 seconds, it was necessary to proceed with the dynamic analysis which was less heavy than the one caused from the wind action.

It has turned out to be less severe than that caused by the wind.

In order to evaluate the concentration of stress in relation with the sudden variations of section along the tower, a tridimensional model was elaborated with "shell" elements.



FEM model realized with "Shell" type elements: the colour relates to the tension state

Subsequently, we concentrated on the state of repair of the antenna and identified a lot of micro cracks on its surface and a reduction of the reinforcement bar section. Three factors led to the degradation of the antenna cortical part: remarkable wind inflexion, concrete carbonation caused by air or rain carbonic anhydride, breaking up of the surface owing to frost or thaw.

Concrete cortical disjunction

Due to the high work of the materials as well as the reduction of the steel bar section and of the concrete resistance, a pervasive reinforcement work is necessary. For this reason it has been planned to cover the surface with a material made of three strata of carbon fibre imbued with polymeric matrix *in situ*; these materials, called composite, should be more functional than the "béton-plaqué" traditional technique, not only because of their lightness and laying-on-work easiness, but also because they do not change the typical antenna slimness.

Following some structural analyses carried out with modern methods and after a comparison with the 1937 tests, we learned that if there had been no degradation, the tower would have a sufficient degree of safety, even with the wind or seismic action. The materials used, beton and steel, showed high quality and the static tests contributed to a dimension that is still acceptable today. However, degradation of the surface of the antenna needs a calibrated work that stops the corrosion of the reinforcement; restores the concrete cover; and increases the rigidity in order to eliminate future cracks. The main effects of the application are on the last resistance while the flexural rigidity results are not so high because of the reduced thickness of each stratum of carbon.

A correct static restoration of such a meaningful work of the past will hopefully provide the opportunity for a recognition of the scientific and technological culture which marked the Turin school at the beginning of the 20th century in terms of calculation of concrete structures and which produced significant works for the history of technology.

For further information:
De Secondi Roberto, e-mail: robyds2000@hotmail.com
Zunino Raffaella, e-mail: raffazu@libero.it