

Evaluation of the Structural Integrity of Brick Towers: The Sineo Tower-house in Alba (CN)

by Graziano Cau and Cosimo Perrone

Tutor: Giuseppe Ferro

Co-tutor: Giuseppe Lacidogna

The research study has the objective to evaluate the structural integrity of the Sineo Tower-house in Alba, for eventual interventions to guarantee the structural soundness and/or for restructuring the building.

The historical importance of the building demanded non-destructive techniques of inquiry, which, at the same time, proved to be practical for the rapidity of application of the tests and for the resulting data which proved to be important both on a qualitative and a quantitative scale.

The non-destructive tests used in this study are: *thermographic analysis; endoscopic analysis; the Flat-jack test; and the acoustic emission test.*

The study can be schematically divided in three parts as follows:

- In the first part a geometric-topographic model was constructed and data was gathered from the non-destructive tests (Pnd).
- In the second part the data collected in the different Pnd was examined, discussed and ordered in practical tables and graphs.
- In the third and last part a cross-analysis of the data, obtained from the different tests, was done in order to come up with theories for some of the causes of the phenomena observed.

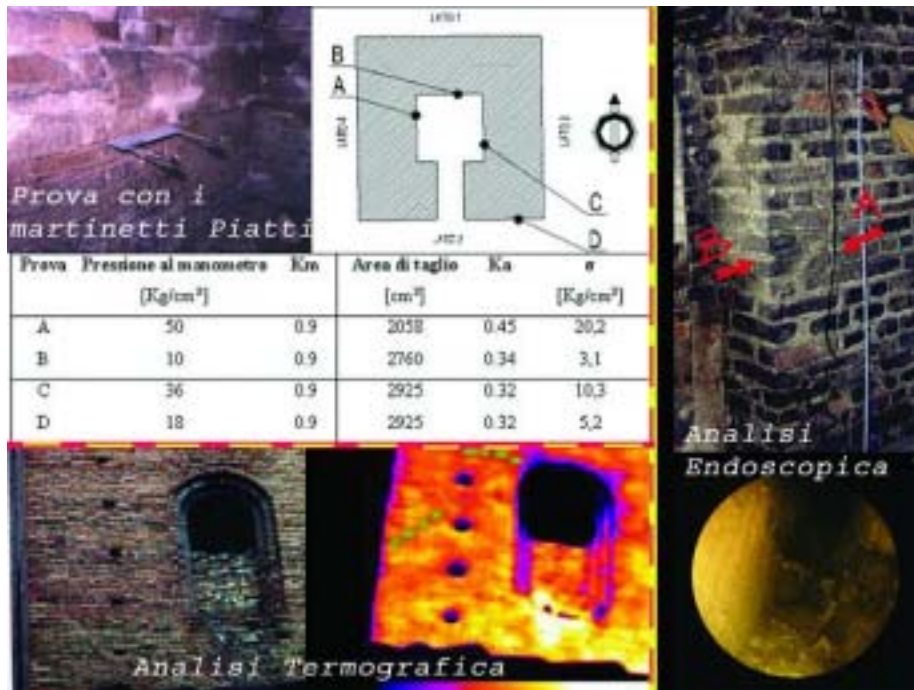
The Thermographic analysis was applied on all four sides of the tower with the intention of detecting the presence of eventual abnormal heat distribution to be studied more thoroughly later on .

The analyses made it possible to locate certain phenomena like the damage of the building due to infiltration of rain-water; the presence of sub-superficial damage; the mortar joints deterioration; ect.

The endoscopic analysis was used to highlight the stratigraphy of the wall, the possible microscopic defects of the material, and the geometric nature of the cracks.

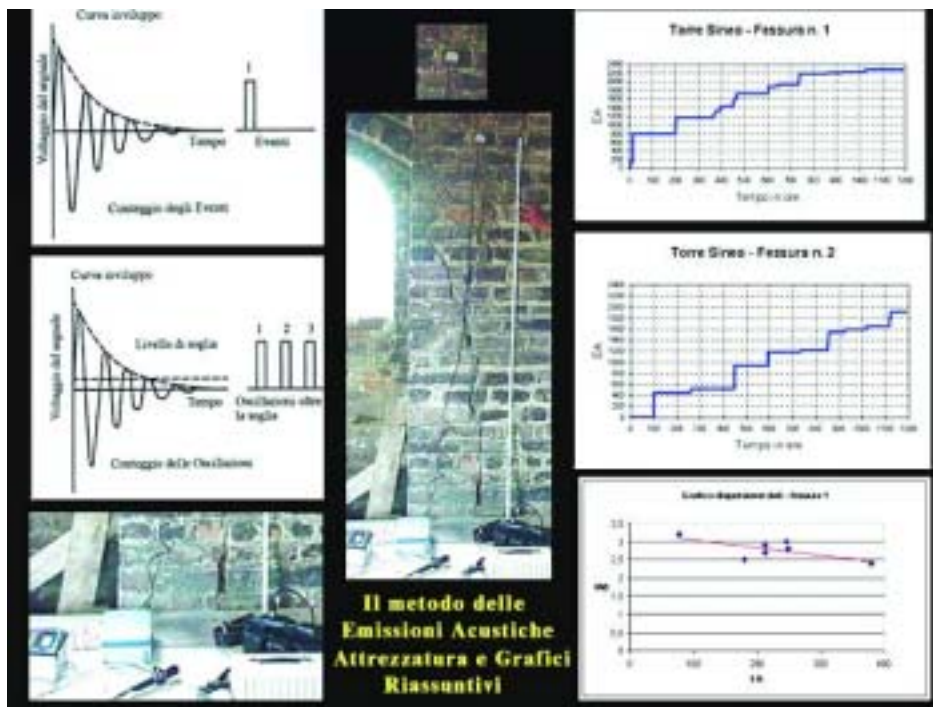
The endoscopic images were analysed one by one, comparing a visual observation with the data collected on the spot. Conclusions were drawn from the endoscopic analysis: the cracks found were due mostly to poor original manufacturing of the wall; the wall texture proved not to be homogeneous between the inner and the outer surfaces.

With the flat-jack test it was possible to measure the wall's tensional state. The tests were applied, where possible, in four points of the tower's underground floors and the values of the push-back pressures due to shear stresses were measured. The tension values measured do not result in line with the tension values calculated with the analytic testing. The slant of the tower and the empty spaces in the upper portion are the main causes of these deviances.



Thermography, endoscopy and flat-jacks

The monitoring of two of the towers flaws has been carried out using the acoustic emission (EA) method. The two gaps have been observed for a total of about 1194 hours. It was so possible to draw cumulative diagrams showing the oscillations in time. From the analysis of these graphs, it was possible to evaluate the evolution of the gapping process, which seems to diminish, even though the cracks can't be seen on the surface.

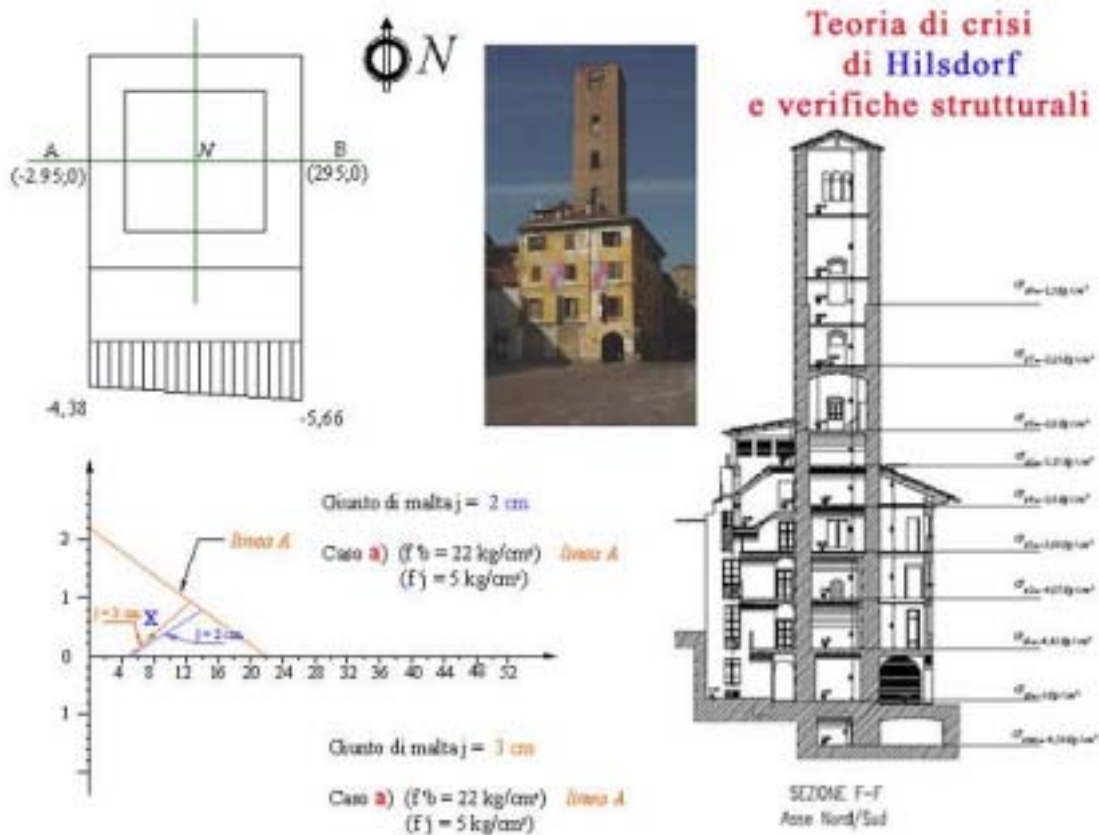


Acoustic Emission, equipment and graphs

In reference to the tremor which occurred on the 21st of October 2000, we tried to verify a correlation between the acoustic emissions surveyed and the seismic events registered during the period of study.

The dispersion diagram resulting from this comparison show how the gapping events monitored result as stabilizing for static loads rather than for dynamic loads.

Finally, in regards to the structural verifications, we surveyed the load capacity of the structure by means of the analysis of the loads, the critical load test, the checking in combined bending & axial load and the Hilsdorf crisis criteria; therefore the structure has to be analysed by a static approach.



Hilsdorf crisis criteria and structural checking

For further information, e-mail addresses:

c.grace@inwind.it

mperr@inwind.it

Maintained by:

CISDA - HypArc, e-mail: hyparc@polito.it