POLITECNICO DI TORINO
FIRST SCHOOL OF ARCHITECTURE
Master of Science in Architecture Construction City
Honors theses

Acoustic and lighting simulations for the modern use of the ancient theatre of Syracuse

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Place for excellence for hearing, but also for seeing, as indicated from the Greek etymologic origin "*théatron*", "*place where to see*", the ancient theatre presents today two sides: an architectural one, as archaeological site, and an artistic one, as place of entertainment. This double cultural heritage often generates conflict in the manner of use, so in ancient theatres the conservation rules have sometimes to collide with the intense use made during the summer theatrical season. The result is that the modern use of ancient theatres for spectacles and performances is often compromised by a damaged situation of the theatre itself. This damage is caused by natural erosion, constant visits of tourists at the archaeological site, besides the inappropriate usage of the structure as modern stage.

This thesis presents a research conducted on the Greek theatre of Syracuse from the point of view of acoustic and lighting comfort: in this theatre the not-audibility is confirmed at the furthest positions of the *cavea*, while any investigation on the visual conditions of the spectators has been conducted before. A parametric study realized through technical software (Odeon ® version 10.1 and Relux ® 2012) has been realized by adding in the theatre different scenic elements to evaluate their influence on passive acoustics and solar radiation.

The theatre of Syracuse as archaeological site and place of entertainments: daily and nocturnal usage

The first part of analysis concerns how the acoustical and visual conditions of the ancient theatre change with the introduction of a specific scenery. The used spatial model is based on the scenery realised by OMA in 2012 for the *48th Edition of Classical Plays at Syracuse's Theatre* organized by INDA.

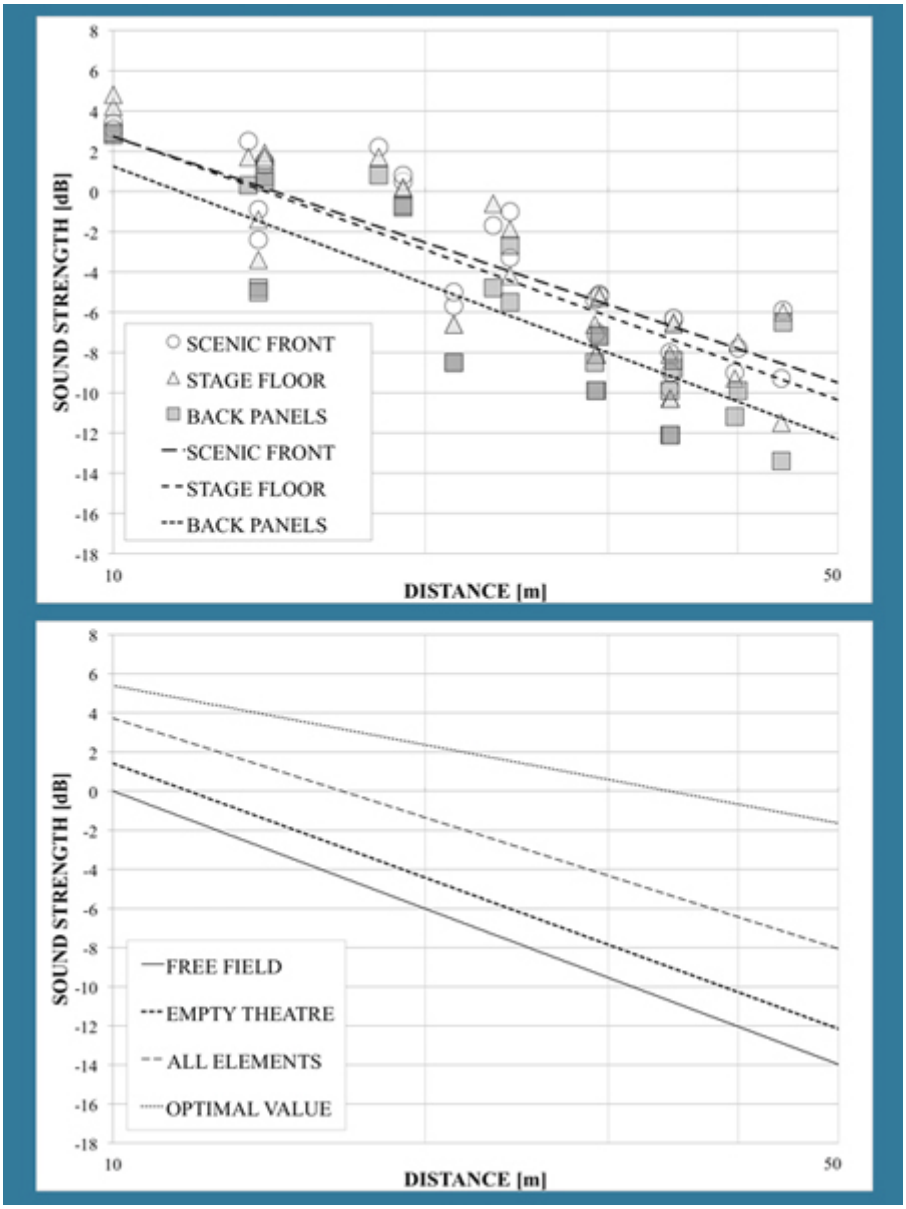
For the acoustic part, eight alternatives, based on different properties of sound source, its position on the stage and the material of the *cavea*, are investigated. To verify the acoustic situation of the theatre during a play, the conditions with and without the scenery are simulated, while taking into account the presence of background noise, as well as the directivity of a talker and the frequency spectrum of the human voice.

For the lighting part a methodology for the approach of the visual comfort of the audience in an open-air theatre is presented and applied on the chosen scenery. It is historically attested that the orientation of the ancient theatres did not follow any rule related to the solar path, but it was mainly influenced by pre-existing urbanism of the theatre location; on this basis, it has been conducted an investigation, during the hours of daytime use of the theatre, sub-divided in three consequential phases: I. Shadows Maps, II. Luminance Distribution, III. Glare Verification.

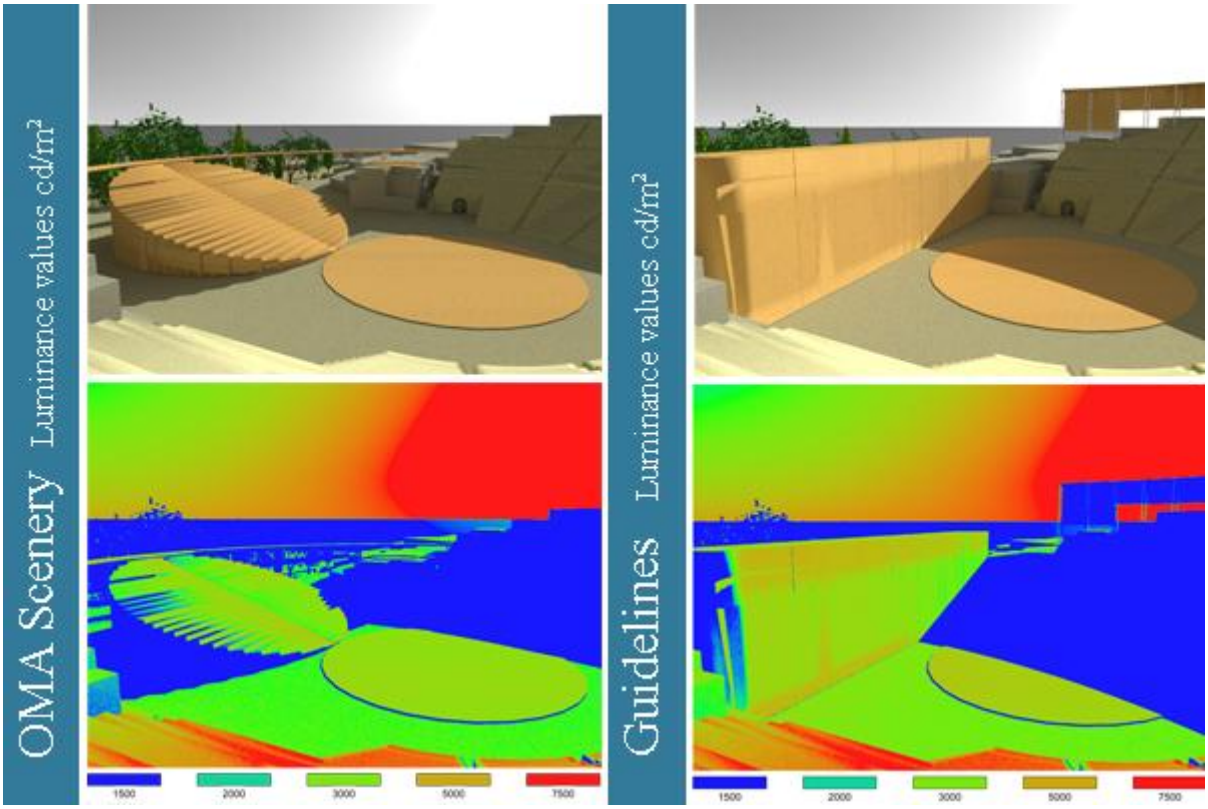
From the results emerged the necessity of more detailed investigations and an influence on the acoustic and visual comfort of the audience determinate by the scenery.

The second part of analysis is centred on the verification of the propositions of three scenic elements hypothesized in the ancient theatre architecture: Scenic Front, Stage Floor, Back Panels. The previous comparison between the condition with and without the scenery allows to establish guidelines for the scenic design, with the principal purpose of preserving and improving the original acoustic apparatus. The results have been evaluated on the base of measurements realized on-site, that allowed a calibration of model of the theatre in empty conditions.

From the lighting point of view, since the daylight analysis defined potential elements of discomfort for the viewer, due to glare or high contrasts of luminance between scenery and sky, through an integrated approach of acoustic and lighting design it has been possible to solve those problems, or at least reduce the portion of sky visible to the audience seated in the most uncomfortable positions, increasing also the shadows covering the *orchestra* area.



Improvement of the sound propagation: calculation of the Sound Strength (G)



Limitation of glare and high contrasts of Luminance (L) between sky and scenery

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