2023

Projet de Fin d'Études

Département Génie Civil et Construction

Theodora Grosomanidi

Elève ingénieur, double diplôme

Tuteur professionnel : Will Laufs

Tuteur académique : Daniel Weisz-Patrault

Modular free-form system for immersive entertainment spaces - Structural study of 3D printed metal connector nodes

Projet réalisé au sein de Laufs Engineering Design LLC

46-01 5th St Long Island City, New York NY 11101, USA

March 1, 2023 - August 31, 2023

Acknowledgements

I would like to acknowledge and give thanks to my supervisor Will Laufs, who made this thesis possible. I would like to thank my academic advisors Professor Charis Gantes from NTUA and Professor Daniel Weisz-Patrault from ENPC for their support and guidance throughout this research project.

I would also like to express my appreciation for the support and patience of my colleagues at the office, with special thanks to Alexey Nefedov for his willingness to answer my numerous questions and share his knowledge.

Last but not least, I would like to thank my family, without whose support I would not be here today.

Abstract

This report summarizes the study carried out on the design of the nodes of a digital theater space truss dome, as well as the study of variations on the possible attachment methods of the interior insulation panels and loudspeakers to the main structure. This work was completed in the New York office of Laufs Engineering Design within a six-month period.

The missions entailed first doing research on the different typologies of domes and nodes (Mero, Triodetic, Stamped, Unistrut, etc.) with the aim to gain understanding of their pros and cons. Then developing the sub frame structure supporting the insulation panels and studying different variations to connect to the main structure (existing or new). Also, the global model of the dome theater geometry was analyzed. Finally, the new node geometry has been studied in detail and verified structurally under the loads from the global model.

This thesis shows an original node design for space trusses, tested for the requirements of the Limes360 digital theater. It focuses on the node's verification and lastly its weight optimization within the capacity of the FEM software used. Finally, the required 1:1 testing was not available to be performed during the time of the thesis, but it is necessary and will be done before the construction phase of the project.

Keywords: steel, nodes, freeform dome, space truss, attachment details