

Similar design of retractable roof in two different sizes – identical motion planning?

Dr. Martin JENNI^a

^a PFEIFER Systems, Austria
Sonnenstrasse 8, 6822 Satteins

Abstract

Retractable membrane structures are used in many different applications, including architectural design, event spaces, and temporary shelters. The structural design and motion planning of these structures require careful consideration of several factors.

The design of retractable membrane structures must take into account the load-bearing capacity of the material used, as well as wind, snow, and other environmental factors. The lightness of membrane makes it the ideal material for wide span structures and lightweight architecture. Nevertheless, the unique properties of lightweight structures with membrane create unique challenges when trying to scale one design for different sizes of structures.

The motion planning of retractable membrane structures must consider factors such as ease of operation, speed of deployment and retraction, and the safety of both the structure and the people using it. Decision-making factors for motion planning include the intended use of the structure, the size and shape of the structure, and the conditions in which it will be used. Furthermore, installation and maintenance need to be considered from the beginning. The intended use of the structure has a big impact on the risk analysis for a machine. Often it is overlooked that a retractable roof is closer to a machine than a structure.

During the design process for the retractable roof for a rectangular event space in New York City, different designs have been compared to each other to fit best the use case. In this process the design of a small but highly sophisticated retractable roof of Wine Castle Koarl Thaller was identified as ideal. The size would raise from 320 square meter to 1600 square meter. A detailed comparison and evaluation of the structural upscaling made bigger changes in the design necessary. The general design idea could take over, but several solutions at the drive system especially could not be upscaled and needed new development.

Finally, all computer design and models don't replace a real mock-up. Mock-ups include anomalies from manufacturing, installation or just wrong design decisions and make them visible very early. There is no mock-up where I haven't learned something about the project, machine or design.

Keywords: Lightweight structures, retractable roofs, moveable structure, motion planning, upscaling, mock-up