# Leading Architecture Firm Accelerates Delivery of Innovative Lightweight Structures

## Powerful Combination of SGI Compute Platforms Reduce Time to Market by Efficiently Modelling Complex Umbrella Structures

**Key Facts**

**Organization:**
SL-Rasch GmbH

**Location:**
Germany

**Application:**
Architecture & Engineering

## Business Overview

Since 1986 SL-Rasch GmbH has been a leader in the use of sophisticated technology to support the design, construction and exhibition of special lightweight structures including tents, foldable umbrellas, convertible textile roofs and domes. With 200 employees, SL-Rasch has built its reputation for delivering high quality 'minimal surface structure' products, by moving beyond the traditional sequential approach of architecting and then engineering a shelter solution to developing a unique simultaneous architectural engineering design process.

SL-Rasch specialises in meeting the specific needs of clients in the Middle East, in particular Saudi Arabia where its work with large umbrellas focuses on making life more comfortable in hot weather for large crowds of pilgrims visiting Mecca and other holy sites.

## Issues & Challenges

Although 'Minimal Surfaces' are light and structurally efficient, they present significant challenges in their design and construction. The core capability that enables very large membrane structures to be produced is also what calls for specialist expertise.

Lightweight double curved structures and the spaces they are being designed to cover can only be accurately studied in 3 dimensions. Small physical models, while useful, are difficult to analyze and scale up to real size. It is therefore essential to use a series of computer simulations in order to identify and understand the impact of different wind conditions on the structure, especially umbrellas when they are opening or closing and are at their most awkward and vulnerable position.

## SGI Solution

Significant computing power is required for, amongst other tasks, long term wind simulation on highly flexible lightweight structures through large scale models with high numerical grid resolutions. To manage the huge quantities of different types of data involved and the specialist applications the company uses, SGI proposed a High Performance Computing (HPC) facility with:

- 64-node SGI ICE 8400 System
- 36-node SGI ICE X System
- 48 core SGI UV100 System with 256 GB memory
- SGI InfiniteStorage 5000

## Results & Benefits

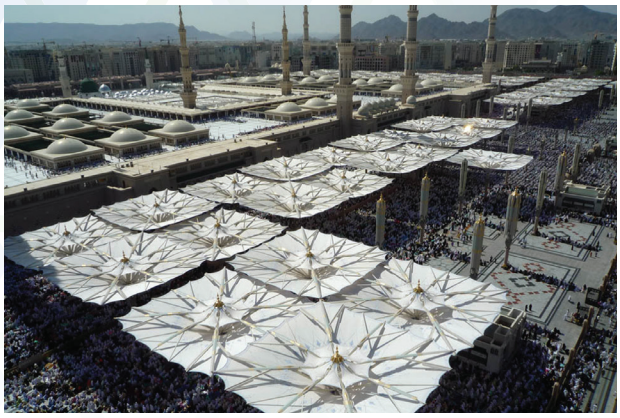
The SGI solution has enabled SL-Rasch to move beyond traditional, standardised engineering approaches that do not fully address the issues involved in designing and producing large lightweight structures. The company now has:

- Increased modelling, simulation, animation and rendering capability
- Reduced requirement for physical prototypes of large umbrella simulations saving time and costs
- Enhanced safety margins on designs and quotations
- Reduced per node energy cost
- Faster project turnaround times

In real life it is not practical to build numerous variations of a design and then use wind tunnel to test alternate weather conditions. Yet, it is critical that the wind interaction with the structure is fully understood as this affects the material used, the design and meeting of safety requirements.

With SGI, it is now possible for SL-Rasch to examine all aspects of wind-loaded membrane structures in the simulation environment – different wind speeds, directions, steady or intermittent, over long periods of time. To undertake this work, SL-Rasch use an innovative synthetic wind velocity field generation technique that models rapidly changing wind inflow boundary conditions with realistic micro-meteorological statistical properties. Once again, this is achieved through SGI computer and storage technology running ESI's PAM-Flow, PAM-Crash and OpenFOAM simulation software which helped to increase the accuracy of the final design and stability of the finished product.

To date, SL-Rasch has delivered 250 large lightweight structures to Saudi Arabia and the company is now looking at umbrellas up to 50M in diameter.



## The SL-Rasch and SGI partnership

SGI technology enables SL-Rasch to gain maximum benefits from the mix of software it uses during the complex process of designing, manufacturing and installing its market leading products.

SL-Rasch has developed the 'SL Design Program Suite' specifically for the design of lightweight structures and it enables the rapid modification and comparison of different shapes within the architectural and design process.

In addition, SL-Rasch has developed a Finite Element Program which can generate the force equilibrium models needed for complex 3D structures such as cable nets, lattice domes and shell structures. With the elastic properties of each of their single members, and the precise geometry of the membrane under the design pre-stress load, the structure can be pre-tested as a virtual prototype under applied loads; even folding of these structures can be simulated. When the design process is completed, the data is sent by direct link to computer controlled manufacturing machinery (CNC) devices, like milling machines, laser and water-jet cutting and 3D printing devices, providing high precision in building execution.

SL-Rasch uses a mix of specialist applications for analysis of complex, unsteady and turbulent fluid flows including:

- OpenFOAM
- Customized ESI Software: PAM-Flow; PAM-Crash
- Windows for Rendering using 3D Studio Max and V-Ray
- Thermal Simulation software

## About SGI

SGI, the trusted leader in technical computing, is focused on helping customers solve their most demanding business and technology challenges.

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