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ISIN FR 0004110310

Contact

ESI Group
Céline Gallerne
T: +33 (0)1 41 73 58 46
Celine.Gallerne@esi-group.com

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German architecture firm SL Rasch uses ESI's Virtual Performance Solution to achieve architectural excellence in Medina and Mecca

Paris, France – October 20, 2014 – ESI Group, pioneer and world-leading solution provider in Virtual Prototyping for manufacturing industries, announces the recent success of our client, SL Rasch: an architecture firm based in Germany that specializes in innovative buildings and lightweight structures. SL Rasch recently completed two complex architectural projects at the sacred sites of Medina and Mecca. The first was the design of foldable umbrellas that now protect pilgrims from the sun in the Medina Haram Piazza and the second was the design of the Mecca Royal Hotel Clock. Using ESI's flagship software, Virtual Performance Solution, SL Rasch confidently investigated innovative designs and replaced physical models by virtual tests.

Today, the millions of pilgrims that travel every year to the Great Mosque of Medina, in Saudi Arabia, are sheltered by more than 250 hydraulically powered, foldable umbrellas, each measuring 26 x 26 meters. These translucent umbrellas are folded at night and open up during the day to create a micro-climate beneath them that is up to 8°C cooler than the surrounding area. Pilgrims visiting the important holy site in Mecca can admire the Mecca Royal Hotel Clock, situated at the top of a 601m high tower, which became the second tallest building in the world in 2012.

In order to test their designs of umbrellas for Medina SL Rasch initially used reduced scale physical models, but found that approach to be limiting. **Dr. Mahmoud Bodo Rasch**, CEO of SL Rasch therefore approached **Dr Eberhard Haug**, co-founder of ESI Group and author of the Lightweight Structure Analysis code "LISA", seeking to collaborate in applying simulation methods in the evolution of more elaborate designs for these complex structures.

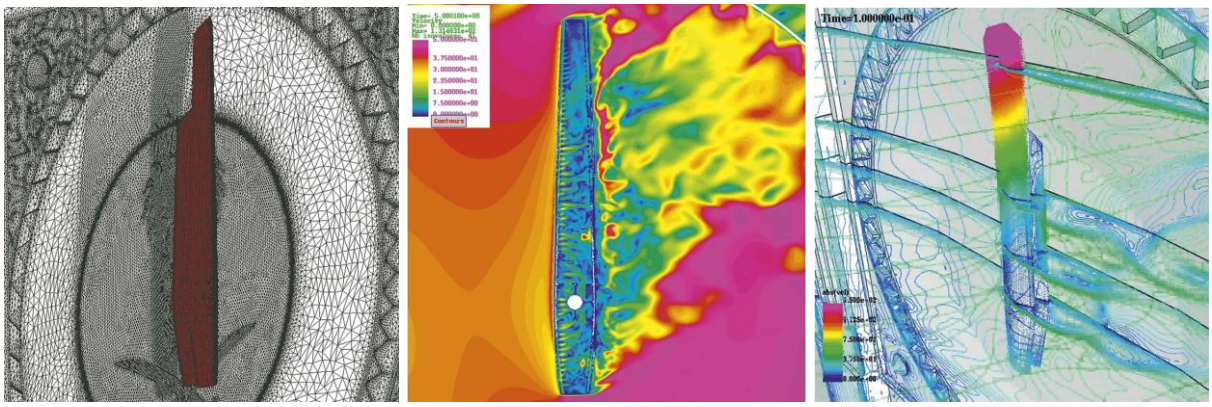
SL Rasch then virtually built and tested different types of structures using Virtual Performance Solution, ESI's software that enables the assessment of all domains of product performance around a single core model. This required great care because of the complex geometry and importance of the architectural appearance of the umbrella's double curve structure. In particular, a form finding process was used to determine a shape that would result in optimal minimum energy – necessary to guarantee that the membranes would last in time and under extreme weather conditions.

For structural analysis of turbulent wind loads on such lightweight structures, the team used Fluid-Structure Interaction (FSI) simulations, coupling Computational Fluid Dynamics (CFD) with Computational Structural Dynamics (CSD); both available as part of Virtual Performance Solution. SL Rasch and ESI co-created special tailor-made modules for modelling naturally turbulent wind loads and optimizing the shape and structure of the umbrellas. These were then used in computer simulations that investigated the safe folding and stowing of the giant umbrellas, taking into account gravity, overlaps, and wind loads. ESI's unique expertise in the simulation of airbag folding for the automotive industry proved to be highly relevant throughout the studies.

"With the know-how of ESI experts and the capabilities built into ESI's advanced CAE software solutions, designing our innovative structural systems became possible," comments **Dr Rasch**, Founder and Owner of SL Rasch GmbH.

Above: The umbrellas now in place at the Piazza of the Prophet's Holy Mosque in Medina. ©SL Rasch

Virtual Performance Solution also helped SL Rasch to overcome significant engineering challenges when designing the Mecca Royal Hotel Clock; constructed as a high strength steel structural skeleton clad with lightweight ornamented carbon-epoxy sandwich panels. The giant hollow-section composite clock hands - 23 meters long in the case of the minute clock hand - presented a special challenge as SL Rasch had to ensure these were aerodynamically stable even under high wind velocities and pressure; especially in the least favorable 12 o'clock position, where the danger of periodic aero-elastic flutter was highest. The team performed wind tunnel test and CFD calculations before FSI simulation allowed them to validate their designs.



Above (from left to right): (1) Mecca clock; 2D surface mesh of the clock hands, (2) clock hands flow velocity contours, (3) clock hand velocities, studied using Fluid-Structure Interaction method. ©SL Rasch

By using simulation, instead of building and testing physical prototypes for these two complex projects, SL Rasch was able to test many versions of the design and achieve optimal results while, at the same time, addressing all applicable safety requirements. This study also spared SL Rasch the production of physical prototypes, thereby saving time, considerable costs and environmental waste.

For more information about Virtual Performance Solution, please visit http://www.esi-group.com/virtual-performance-solution

For more pictures of these amazing projects, please visit the page dedicated to the folding umbrellas and the one about the Mecca Clock Tower on SL Rasch's website

About SL Rasch

SL Rasch specializes in Special Buildings and Lightweight Structures; integrating architecture and engineering. An interdisciplinary team of professionals, composed of architects, structural, mechanical and aeronautical engineers, physicists and computer specialists together with in-house departments for project management, graphic design and model making, brings state of the art techniques and knowledge to design development and problem solving. For more information please visit www.sl-rasch.com.

About ESI Group

ESI is a pioneer and world-leading provider in Virtual Prototyping that takes into account the physics of materials. ESI boasts a unique know-how in Virtual Product Engineering, based on an integrated suite of coherent, industry-oriented applications. Addressing manufacturing industries, Virtual Product Engineering aims to replace physical prototypes by realistically simulating a product's behavior during testing, to fine-tune fabrication and assembly processes in accordance with desired product performance, and to evaluate the impact on product use under normal or accidental conditions. ESI's solutions fit into a single collaborative and open environment for End-to-End Virtual Prototyping. These solutions are delivered using the latest technologies, including immersive Virtual Reality, to bring products to life in 3D; helping customers make the right decisions throughout product development. The company employs about 1000 high-level specialists worldwide covering more than 40 countries. ESI Group is listed in compartment C of NYSE Euronext Paris.

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ESI Group – Media Relations
Céline Gallerne
T: +33 (0)1 41 73 58 46