

Redesco: the challenge of Structural Engineering for Generali Tower and Podium

“Simplicity is Complexity Resolved”

The “twisting” tower in Milano City Life, named today Generali Tower, Designed by Zaha Hadid Architects powerfully soars above the city, being anew landmark with a futuristic mood.

The Architecture of the tower is visible, what we don’t see but makes such a peculiar building physically feasible, are the structures, visible only when the construction is growing. This is the result of the Structural Design by **Redesco (Research-Design-Consulting)**, a true Italian excellence in the engineering sector that has authored the structures of some of the most important buildings of the recent modernisation of Milan.

The Tower

Conceiving and developing the structures for the Generali Tower has been the perfect example of Structure-Architecture interaction. Starting from a complex set of problems, Redesco team applied an holistic approach based on the premise that “simplicity is complexity resolved” (K. Brancusi), thus imagining and implementing a structural system that did match with Architecture, safety, economy, functionality and buildability in the most efficient way.

From the beginning of the project, some main challenges had to be addressed: above all how to cope with the torsion of the tower, induced by the warping of the columns around the core, while choosing the most efficient materials, shapes and construction methods. Once set the conceptual basis of the project in terms of structural members lay-out, Redesco decided, after a thorough evaluation of structural alternatives, to go for a reinforced concrete structure, being the one that maximized the benefit/cost ratio. A more efficient structure albeit extremely more complex to design and calculate than any solution made of steel. Concrete means a highly non-linear material: the structure’s deformations are evolving during and after construction. To control and forecast with precision the evolutive behaviour of the structure has been the key to success, not only in order to understand how internal forces and stresses changed in the structural organism, but moreover to allow the façade, internal elements, installations to be designed to strict tolerances and no waste. The complexity of the spatial resisting phenomenon of the Tower required to dwell into the most advanced Structural Engineering tools and methods, and to perform a substantial amount of research. The leading of ZHA proved to be a key factor to success, since the strict and creative cooperation with the Architects lead to a clean, simple, extremely optimized layout of the structure and a deep coherence of all the building’s elements.

Similar to the challenge of structural physics, the innovation of this project consisted in implementing a method that would pair with the parametric approach of Zaha Hadid Architects. All structural simulations, analysis, drawings and detailing were developed with advanced tools and in-house software that followed the mathematical method set by the Architects in designing the Tower’s shape. The whole Structural Design, from concepts to final construction documentations, has been created by means of parametric tools. The final stage of the Design has also been implemented in BIM, in full coordination with other Design disciplines.

Redesco’s role in the Generali Tower Structural Design has been extended from the initial conceptual stages all the way through to the Construction phase, so that we had the chance to follow the design until the tiniest detailing, rebar scheduling, steelwork joints and details and moreover to cooperate with the

Contractor in defining construction methods, sequences, monitoring of the structural behaviour and checking of results.

The Podium

Redesco has been in charge of the Structures of the “free form” volume of the Podium, which is the visible part above the upper plaza level. The complexity of this Structure arises from the coexistence of an extremely high number of constraints: from one side, the columns could only rest on the regular grid of the parking structures below, on the other side, the freedom of form, internal arrangement, density of functions of the Podium asked for an extremely sophisticated structural strategy. The structural arrangement was born by parametrically coupling of the external surface to be respected and the internal constraints: the whole structural frame was generated automatically by combining all the constraints in a graphic algorithm. Based on this frame, that includes very long spans, column deviations and cantilevers, optimization and recurrent operations have been carried on the structural members in order to achieve the maximum cost-efficiency and structural soundness. All the structures are in steel, including the façade sub-structure that consisted in many hundreds of different frames.

Finally, one of the most challenging aspects of the structure is its being built across a series of structural joints: joints between different parts of the underground parking structure and joints between the Tower base and the surrounding systems. A sophisticated study of details and structural behaviour, that allows each different part to settle independently, has been carried on.

Also for the Podium Redesco has been appointed to design and follow the Structures from the conceptual stages down to the detailing and construction phase.

Redesco's Scope Of Work and Responsibilities for the Tower and Podium

Discipline:

Structural Engineer

Object:

Complete Tower

Freeform part of the Podium (structure above the upper plaza level):

Design Stages:

From Concept to Construction Documents, and Site Assistance

Stages **C,D,E,F,G** (Old RIBA plan of work) or **2,3,4,5** (New RIBA plan of work)

Responsibility:

Engineer of the Records

Design Team:

Mauro Eugenio Giuliani *Engineer of the Records*

Fabio Capsoni *Team Leader*

Gianluca Vesa *Senior Project Engineer*

Paolo De' Angelis *Senior Project Engineer*

About Redesco

www.redesco.it

Redesco (Research – Design – Consulting) is a Structural Engineering Firm, whose first core was established in 1975, and is nowadays one of the leading Italian firms, serving Clients and Architects in the local and International market. Redesco has had a pre-eminent role in the recent high-rise renaissance in Milano, being the Structural Engineer for Generali Tower, Libeskind Tower and working on the Varesine development, an alternative proposal for Allianz Tower structural system and many other challenging projects.

At present day Redesco is working on highrise projects in Milan, Geneva, Cyprus and Malta.

Mission

Merging broad vision with focused specialization, we simply design and enable outstanding structures.

We focus on Structures, from conceptual design to site supervision. We work for Investors as well as Construction Companies, because we like to follow our designs from the initial sketches to realization: we sharpen our skills in imagination as much as in making things real. We believe that experience in the field must go along with research, theory and creativity.

Being Structures the focus of our activity, we do not limit ourselves to a specific domain: our work encompasses buildings, highrise buildings, infrastructures, bridges and footbridges, special structures, construction methods and research.

We use materials at their best, being them concrete, pre or post-tensioned concrete, steel.

And we cherish our greatest asset: creativity as the result of deep knowledge, culture and passionate commitment.