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Casa Corriere – RCS Media Group pavilion for Expo 2015

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Abstract

In 2014 Rizzoli-Corriere della Sera Media Group S.p.A. decided to have a pavilion at the Milan Expo 2015 in order to promote the activity of the group in daily newspapers, magazines and books, radio broadcasting, new media and digital and satellite TV. This paper presents the design philosophy, the project development and the construction of the demountable pavilion designed by Monica Armani architects and based on a transparent volume made of XLAM columns and inflated PVC crystal cushions. The lightness of the inflated part contrasts with the weight and the mass of the vertical and horizontal wooden structure. The result is a sophisticated construction with a lightweight envelope which can be adapted to the weather conditions and solar radiation. The main structure of the pavilion, with a main ground floor and a small mezzanine, is based on an XLAM structure composed by a rigid basement, vertical rectangular columns with different orientations, a rigid central core and a flat roof with two large skylights. The series of rectangular two-layers air cushions used for the facades and the two skylights are connected to the glulam with keder rail profiles. The facade of the pavilion is the most characterizing element of the construction and is based on a two-layer system stabilized through the air pressure. This solution minimized the weight of the pavilion and provided adequate insulation of the internal spaces. The pavilion has been dismantled in November 2015 and it will be used in several temporary events planned in the next years.

Keywords: Expo 2015, Corriere della Sera, RCS, PVC-Cristal, ETFE, Pneumatic, facade, roof

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1. Introduction, Monica Armani Architects and Maco Technology

Monica Armani Architects is a design studio based in Trento, Italy. It is based on an interdisciplinary approach with a solid background on materials and construction. For Monica Armani Architects design means ideas, small and great inventions, endless care of every detail, synthesis between the observation of the evolution of behaviour and experiences. A very powerful tool, which can be applied to everything that man impends, a set of activities that increase the value of each work and make it at the same time sustainable and coherent. A design object is not just what you see, but all that it represents. The design approach of the studio reflects feelings and thoughts, the story of the team of architects involved and the deep connection with the territory in which the studio was established and operated: the northern alpine region of Italy, where tradition and innovation have found a sophisticated balance and design is the common thread.

The recent projects range between architecture, industrial design and teaching. The design studio focuses its attention on finding the harmony between form and timeless design, in a continuous process of research and innovation. The aim is to create a unique language that allows Monica Armani Architects to collaborate with different partners, all with a common denominator: great passion and ability to do things.

The design activity of the studio is based on a constant cross-over between research and innovation, this approach put Monica Armani Architects in a leading position in the current Italian and international panorama in the field of contemporary architecture and industrial design.

Casa Corriere for the Milan Expo 2015 (figure 1) is the first collaboration between Monica Armani Architects, the first step of a long-term collaboration which led to cutting edge projects such as the pneumatic structures developed for the Trento Economics Festival in 2016 and 2017. Founded in 2012, Maco Technology srl approached the market of membrane structures with a strong academic background of the co-founders with PhDs on pneumatic structures and the mechanical performances of architectural coated fabrics and foils. The focus of the company gradually moved towards the advanced design of complex lightweight structures and artistic installation. The holistic approach includes digital parametric tools for the 3D modelling of the components, FEM simulations, environmental analysis and optimisation of the storage and transportation volumes (Beccarelli et al., 2015). The file-to-factory approach allows the rapid and accurate manufacturing making possible challenging projects within a tight timeframe. Recent projects include collaborations with the main international architectural firms such as Diller Scofidio +Renfro (New York), MAD architect (Shanghai) and Foster + Partners (London).



Figure 1: View of the EXPO 2015 site in Milan

2. The design approach for Casa Corriere, the RCS pavilion for Expo 2015

In 2014 Rizzoli-Corriere della Sera Media Group S.p.A. decided to have a pavilion at the Milan Expo 2015 in order to promote the activity of the group in daily newspapers, magazines and books, radio broadcasting, new media and digital and satellite. Monica Armani Architects developed an innovative project based on a prefabricated timber construction able to be easily assembled and disassembled, in line with the principles of TIMELY ARCHITECTURE developed by Monica Armani Architects for the temporary structures.

The design approach is based on CAD-CAM technologies, which allowed to meet the demanding requests from the client delivering at the same time a customized pavilion structurally safe and easy to assemble. The connections allowed the disassembly of the pavilion at the end of the EXPO 2015 and the efficacious transportation and storage until the next use. Reduced installation costs, reusability, high standards and quality of the details are the main features of Casa Corriere, the pavilion designed and manufactured for RCS Media Group for Expo 2015 (Figures 2 and 3). The built project includes sophisticated connections and technical solutions with the integration of advanced manufacturing technologies and systems for environmental control.

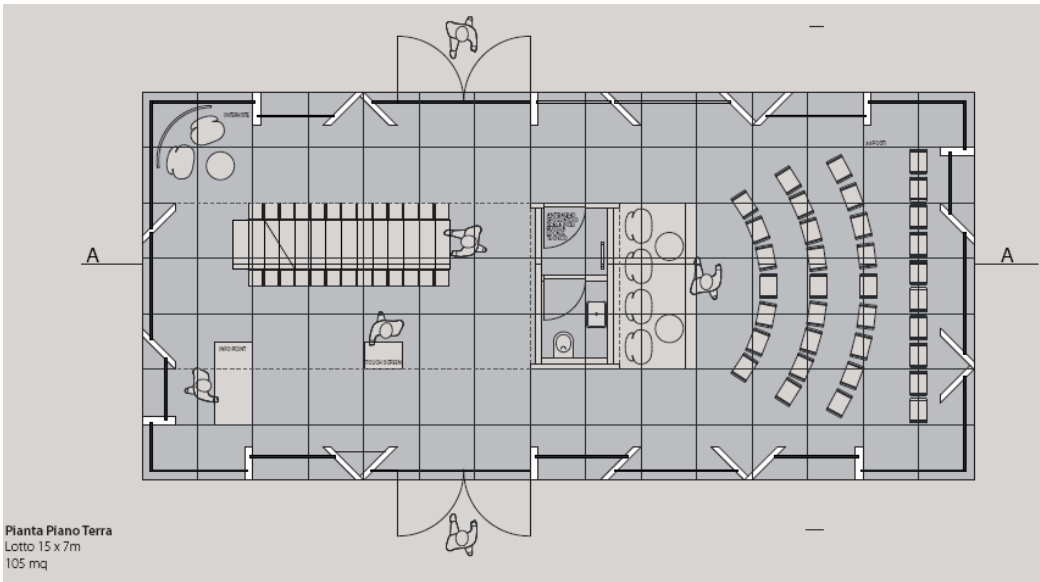


Figure 2: Plan view of the pavilion.

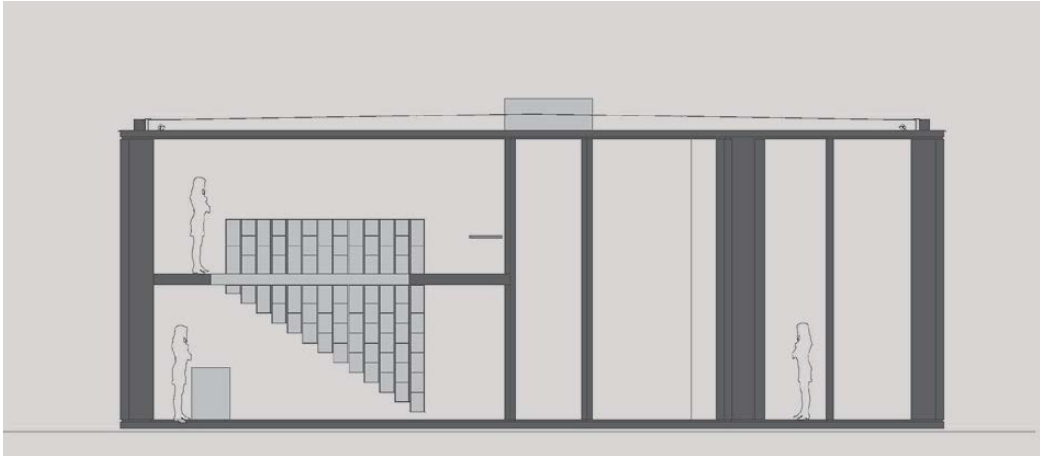


Figure 3: Section of the pavilion.

3. Timber structures

The main load-bearing structure of the RCS pavilion is based on a timber structure made of structural panels made of cross-laminated timber-XLAM arranged overall a regular grid of 140cm x 110cm to support the pavilion with a total dimension of 8m x 14m and an external high of 6m (figure 6).

The façade is strongly characterised by large timber columns 5120mm high with a cross-section of 100mm x 950mm. The 24 columns are arranged around the external perimeter of the pavilion inclined at 90 and 45 degrees providing at the same time support for the roof and a filter between the indoor and the external spaces of the pavilion. The columns are connected with bespoke connectors to the solid timber slab used for the ground floor and the timber beams used to support the roof and the inflated skylights.

The lateral stability is increased by the central core of the pavilion which is also made of cross-laminated timber. The central core is used to host the small toilet and the cabinet for the services of the building, including the pumps for the ETFE roof.



Figure 4: Assembly of the timber structure on site.

4. Inflated envelope

The original project included multilayer glass panels placed in between the timber columns arranged around the perimeter of the pavilion. Due to the short life span of the temporary pavilion, during the development of the project, it became obvious that a traditional glazed façade was not the right solutions for the RCS pavilion. Monica Armani Architects decided to investigate alternative solutions characterised by a similar thermal performance with a fraction of the embodied energy of a glass panel. An inflated membrane façade became the ideal solution able to provide the required structural and thermal performance with a limited

amount of embodied energy. The concept uses air under pressure to achieve the required load-bearing capacity. In addition, the pressurised air chamber considerably increases the insulating performance of a typical single layer membrane facade, which can progressively be improved with multiple layers. Compared with double- or triple-glazed façades, the thermal performance is considerably compromised by the dimensions of the air chambers, which allow a not-insignificant movement of the enclosed air with consequent energy losses due to convection. However, considered the short life span of the pavilion, the overall benefit of this solution was still positive compared with traditional glazed alternatives (Beccarelli, 2015).



Figure 5: Assembly of the PVC envelope on site.

Inflated envelope, based on two layers of clear PVC foils, has been designed to maintain a relatively small thickness of the envelope in order to avoid the waste of floor area. The shape of the cushions is a rectangle with a width variable between 1268mm and 2060mm and a maximum high of 5200mm. On the basis of the results of the structural simulation, due to the reduced mechanical performance of the clear PVC foil, the designer decided to integrate strips of coated fabric, 1300mm far from each other, to retain the external layers of the cushions and reduce the level of stress/elongation in the foil. The membrane envelope includes two large skylights 6318mm x 6488mm and 5720mm x 6488mm. They are based on a three layers cushion with the intermediate layer and the external layer printed with a positive/negative strip pattern. The manufacturing of the fabric panels was executed in safe and clean spaces by highly specialised workers and specific equipment such as computerised cutting tables and

high-frequency welding machines. The manufactured membrane has been easily packed, stored and shipped due to the reduced weight and volumes of the fabric once folded. Once on site, the assembly process was relatively fast and efficient due to the accuracy of manufacture, the aluminium boundary profiles and the reduced weights and volumes to be handled, which required less (and smaller) lifting equipment (figure 5). The result was an overall cost-effective product able to offer an alternative to the main traditional solutions and materials currently in use for transparent façades (Beccarelli and Chilton, 2013).



Figure 6: The external roll blinds (left) and the detail of the connection with the timber frame (right).

Picture by A. Liverani

5. Environmental performance and building services

If compared with a standard double-glazed window, the solution adopted was able to provide similar thermal performance with a total weight of 2kg per square meter compared with the 30 kg per square meter required by traditional double-glazed panels. In order to reduce the heat gains during the day and the warm season, the façade is protected by vertical blinds with an open mesh fabric Serge Ferrari SOLTIS86 ALU/WHITE 2051.

The two large skylights (figure 7) are based on a triple layer solution in order to provide an integrated control of the solar radiation based on a positive/negative pattern printed on the external and intermediate layer which can be overlapped by changing the air pressure in the inner chambers. The air in the cushions is continuously blown through two fans which keep the facade and the roofs at different pressure. Roof cushions are equipped with motor valves which deviate the flow of air in the two different chambers. Through this system, the light transmittance can be adjusted according to needs. At night the translucency of the pavilion is emphasized by LED lights which attract the interest of the visitors and transform the construction in an ideal venue for events.



Figure 7: Detail of the two large skylights with the printed pattern designed to control the daylight.

The pavilion is equipped with a Heating, Ventilation, and Air Conditioning – HVAC system which can operate in summer and in winter. The main unit is placed in the space of the central core of the pavilion. The ventilation conducts and the ventilation nozzles are integrated in the timber structure of the pavilion in order to minimize the aesthetic impact.

6. Conclusions

This paper described the design philosophy, the project development and the construction of the demountable pavilion designed by Monica Armani and Luca Dallabetta of Monica Armani architects and based on a transparent volume made of cross laminated timber columns and inflated PVC crystal cushions. The result is a sophisticated construction with a lightweight envelope which can be adapted to the weather conditions and the solar radiation. The pavilion has been dismantled in November 2015 at the end of the Expo and, thanks to the reduced weight and demountable concept, will be used to promote Rizzoli-Corriere della Sera Media Group S.p.A. in several temporary events planned in the next years.



Figure 8: Casa Corriere – RCS Media Group pavilion for Expo 2015

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References

Beccarelli P., Maffei R., Galliot C. And Luchsinger R.H., (2015). A new generation of temporary pavilions based on Tensairity® girders, *Steel Construction*, 8(4), pp. 259-264

Beccarelli P. (2015). Biaxial Testing for Fabrics and Foils: Optimizing Devices and Procedures, Springer.

Beccarelli P. & Chilton J. (2013). Advantages of lightweight tensioned coated fabrics and foils façades for the building sector In: *Structural Membranes 2013 VI International Conference on Textile Composites and Inflatable Structures*, 9-11 October 2013, Munich, Germany.