



## ParaGlass in Marble Facade / Case Study

### 3-D Glass Fabric Fortifies Thin-Stone Marble Façade Systems

Marble, available in more than a hundred varieties from around the world, has long been a popular architectural material. It offers superior aesthetic qualities and a relatively easy workability. Yet, with advancements in building structures, the use of marble on building exteriors has evolved from massive bearing walls of solid stone to thin stone marble façade systems attached to the building's superstructure. Unfortunately, the thinness that makes these thin-stone facades so economically appealing, also makes them less resilient under forces of changing temperature, seismic loads, gravity, wind, and moisture.

To combat the brittle nature of these marble facades, a variety of materials — glass fabrics, foam, plywood, and honeycomb — each with its own pros and cons, can be employed as a reinforcing backing to the marble cladding. Kunovar & Kamini (Ljubljana, Slovenia), a company with a long tradition in the field of natural stone fabrication, is currently using Parabeam® 3-D glass fabric to reinforce both flat marble façades and curved column cladding.

Parabeam 3-D glass fabric is woven from E-glass yarn and consists of two deck layers bonded together by vertical piles that are woven into the deck layers to form an integral sandwich structure. Because of its inherent drape-ability, the Parabeam reinforcement layer follows the shape of the marble, be it flat or curved.

### Simple Application

Application of the Parabeam reinforcement layer requires no heat or pressing equipment (such as that needed to process glued on plywood or flat sandwich materials). In fact, the only equipment required is a roller and a container of resin. Due to the porous nature of marble, the epoxy resin used to wet out the Parabeam material also provides an excellent adhesion to the entire surface of the stone. When the resin is impregnated, the fabric absorbs the resin, and due to the capillary forces of the piles, the fabric rises to a preset height, evening out thickness variations in the marble and adhering over the entire surface.

Every Parabeam variant — from 3mm to 10mm — can be used to reinforce marble. Of course, the thicker the sandwich structure, the greater the reinforcement strength. Therefore, reinforcement thickness should be driven by the demands of the application. When extra reinforcement is required, Parabeam layers can be stacked wet in wet.

## Quantifiable Advantages

Kunovar has reported less waste since employing the Parabeam reinforcement, reportedly reducing its marble waste from 30 percent to 5 percent. “With Parabeam reinforcement, the marble cracks less easily, and when it does crack, it can be repaired more often,” reports Kunovar.

The Parabeam reinforcement has also allowed the company to decrease the thickness of its stone panels and therefore lower the weight of the overall facade. For example, a column measuring 25 m by 2 m with a 3cm marble façade and a 1cm reinforcement layer weighed 50 ton. Using Parabeam reinforcement, Kunovar was able to shave 1 cm off the marble thickness (bringing it to 2cm) and reduce the column weight by 50 percent. Additionally, lighter reinforced marble requires less robust attachment systems, which equates to additional savings.

Tests conducted by Kunovar show an overall increase in strength of more than 50 percent using Parabeam reinforcement compared to unreinforced marble cladding. While unreinforced marble strength was measured at 210 kN/cm, marble with Parabeam reinforcement was 490 kN/cm. An additional characteristic of 3-D glass reinforced marble is an increase in flexibility (see image).

Future applications for Parabeam reinforced thin-stone marble façade systems could include mobile applications — luxury yachts, private planes, luxury train compartments — where weight plays a critical role.

**For more information, please contact [sales@parabeam.com](mailto:sales@parabeam.com).**