REHABILITATION OF INDUSTRIAL CERAMIC CHIMNEYS.

IS IT:

- [ ] *Product*
- [X] *Technology*
- [ ] *Equipment*

APPLICABLE FOR:

- [X] *Restoration*
- [X] *Rehabilitation*
- [ ] *New Construction*

APPLICABLE ON:

- [ ] *1. Foundations and underground structures*
- [X] *2. Vertical structures*
- [ ] *3. Horizontal structures and vertical connections*
- [ ] *4. Roof and terraces*
- [ ] *5. Façade and building envelope*
- [ ] *6. Finishes and completion elements*
- [ ] *7. Integrated services*
- [X] *8. General strategies for building recovery*

Related companies: *No companies; university research; structural study.*

DESCRIPTION

In historic chimneys to be preserved that need structural intervention.

Substitution of metallic reinforcements already executed in chimneys.

WHY TO USE

To avoid or replace the usual reinforcement system by using steel, thus eliminating the difficult subsequent maintenance, thus improving durability.

HOW TO USE AND APPLY

Many of the original industrial ceramic brick chimneys of the 19th or 20th century are now part of our built heritage, having been preserved as a vestige and witness of a bygone era, in many cities that had their industrial explosion at that time.

Usually, the conservation of these elements as a monument has required structural intervention. In most cases, the reinforcement elements added have been of a metallic nature. Subsequent to their rehabilitation, it is common for these reinforcements to have very low or even no maintenance, due to their difficulty (great height) leaving these steel reinforcements at the mercy of the elements, which in the long run end up causing new pathologies or aggravating the original ones.

The use of non-steel reinforcement systems makes it possible to avoid or replace the use of metallic reinforcement elements.

The reinforcement needs of the chimney will be determined by a process of diagnosis and calculation.

It is common for these constructions to present large horizontal deformations, even appreciable to the naked eye. Currently, without industrial use, these elements are mainly subjected to loads due to their own weight and to horizontal wind and seismic loads. Therefore, their stability and resistance to horizontal actions will have to be especially checked, being critical to the overturning and tensile tests, respectively.

The design of the repairs and reinforcements, or the replacement of the existing ones, according to the needs derived from the calculation, will be one or more of the following or a combination of them:

- Crack stitching: bar type elements that will join the lips of the crack to prevent its opening.
- Crack sealing: Filling and closing of cracks with new material.
- Tensile strength outer rings: to confine and/or strap the structural at one or more points.
- Extensive interior reinforcement: Interior surface layer (to avoid its vision from the outside), to give uniformity and continuity to the facing. It can be of all the height or only a part. As a base for the following type of reinforcement.
- Interior vertical ribs: Bar-type vertical elements adhered to the interior surface, to improve the tensile strength in the most stressed areas.
- Interior-exterior connectors: Elements of union between the interior and exterior reinforcements, so that they work together, avoiding differential movements.

TECHNICAL CHARACTERISTICS

The technical characteristics of the materials to be used will be those required for the project:

- Crack stitching: Carbon fiber, glass or basalt rods, inserted in staggered drilled holes filled with resins.
- Crack sealing: Fluid mortar based on natural hydraulic lime and Eco-Puzolana (without cement).
- Tensile resistant exterior rings: band of mortar based on hydraulic lime and Eco-Puzolana, fiber-reinforced, bicomponent and cement-free, with internal mesh of fiberglass or basalt.
- Extensive interior reinforcement: Same as the previous reinforcement, but in this case with extensive superficial plastering.
- Interior vertical ribs: Carbon fiber laminate type vertical elements adhered to the plaster.
- Interior-exterior connectors: Fiberglass or carbon fiber rope, fiocco type, frayable.

RECOMMENDATIONS AND OTHER INFORMATION

Since the products used for this type of reinforcement are highly specific, it is recommended that the manufacturer be consulted, prior to sizing, on the resistance characteristics of each product to be used, since their sizing will depend on them.

The system is a technology that reduces or eliminates the subsequent maintenance of structural reinforcements in the open air. This lack of maintenance can generate flaws or deterioration of the finish, but it will not generate other structural pathology as it would if the reinforcements had been designed in steel.

EXAMPLES

Reinforcement of ceramic brick chimneys with strength improvement needs (especially tensile).

Replacement of existing metal reinforcements in brick chimneys.

See figures 1 - 7.

REFERENCES / SOURCES AND LITERATURE

Regulations: CTE DB-SE

Commercial products: MAPEI reinforcement systems

WEBSITE OF THE COMPANY

www.bisstructures.com

IMAGES AND CAPTIONS

Fig.1: View of a chimney, now out of industrial use, in an urban park. Note that it was once reinforced with external metal rings, which have now caused new pathologies: cracks in the brickwork due to expansion caused by the corrosion of the steel when outdoors and with great difficulty of maintenance (no maintenance, in practice). *© bisstructures*

Fig.2: View of an exterior side. Note the existing metal reinforcement rings to be replaced. And the central vertical crack to be repaired. © *bisstructures*

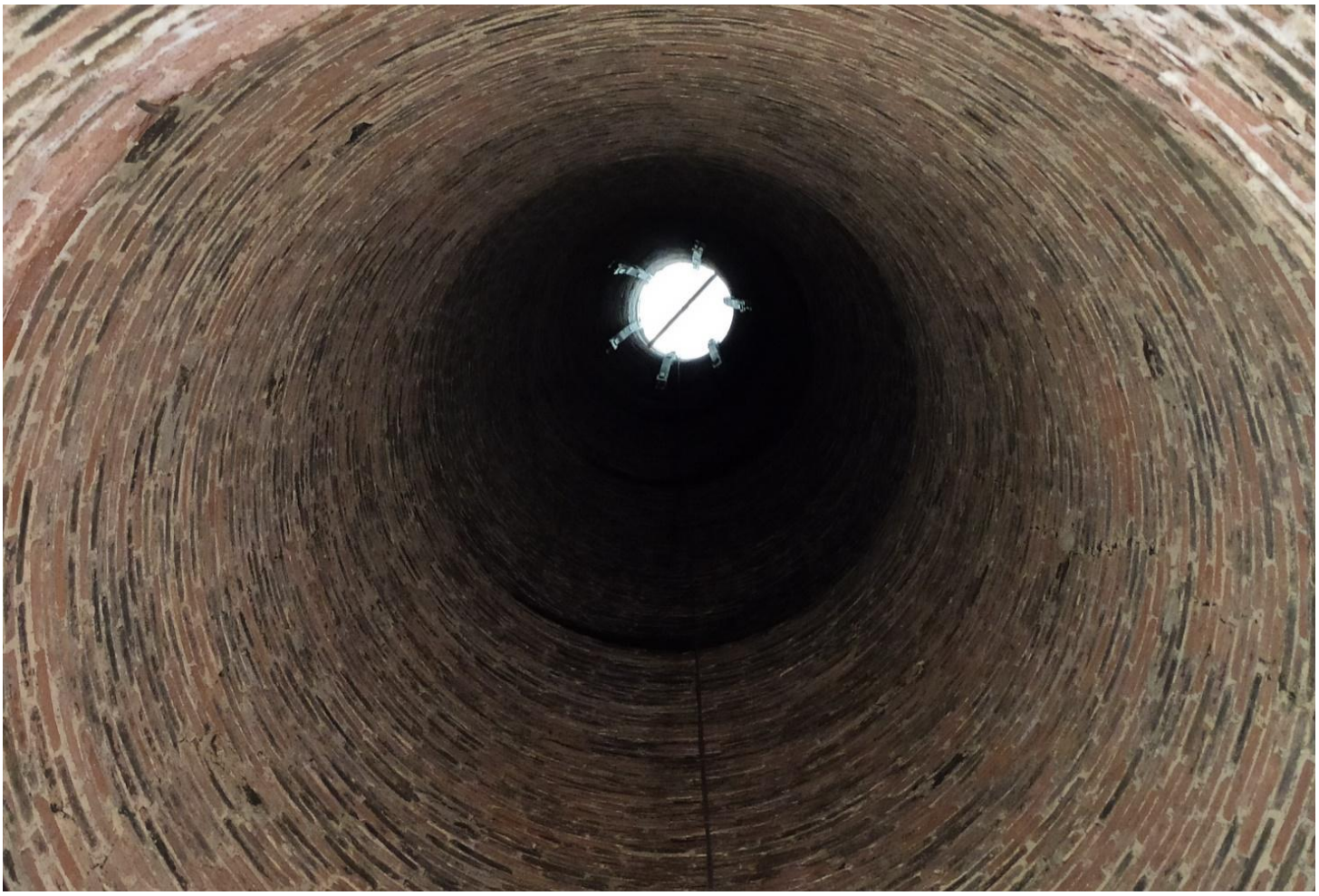

Fig.3: Interior view. Note the existing vertical metal reinforcement profiles in the upper section, to be replaced. ©*bisstructures*

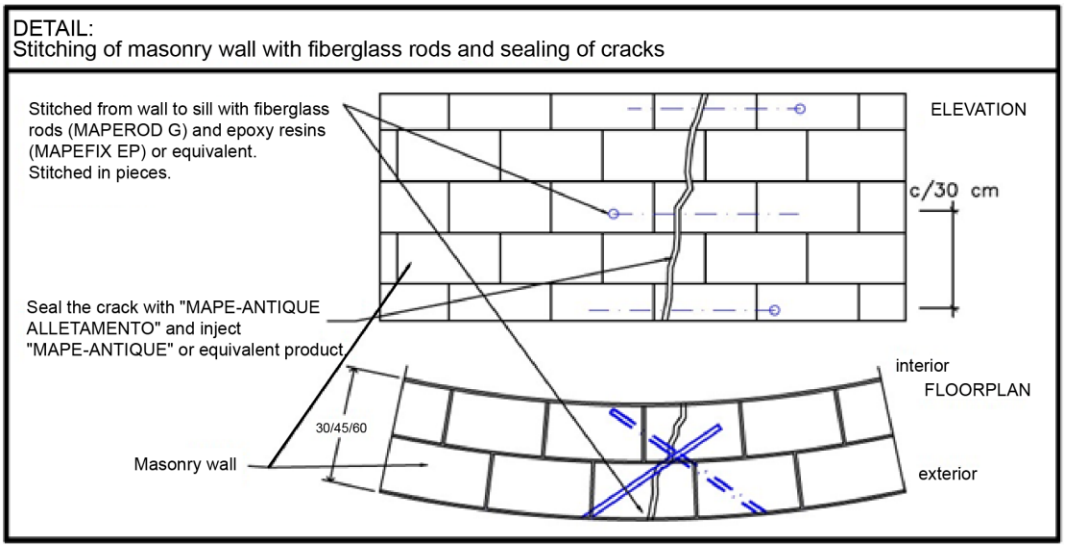

Fig.4: Detail of the repair of the existing cracks, by stitching with fiberglass rods and epoxy resins. Avoiding the use of steel elements that would eventually cause new pathologies due to lack of maintenance. © *bisstructures*

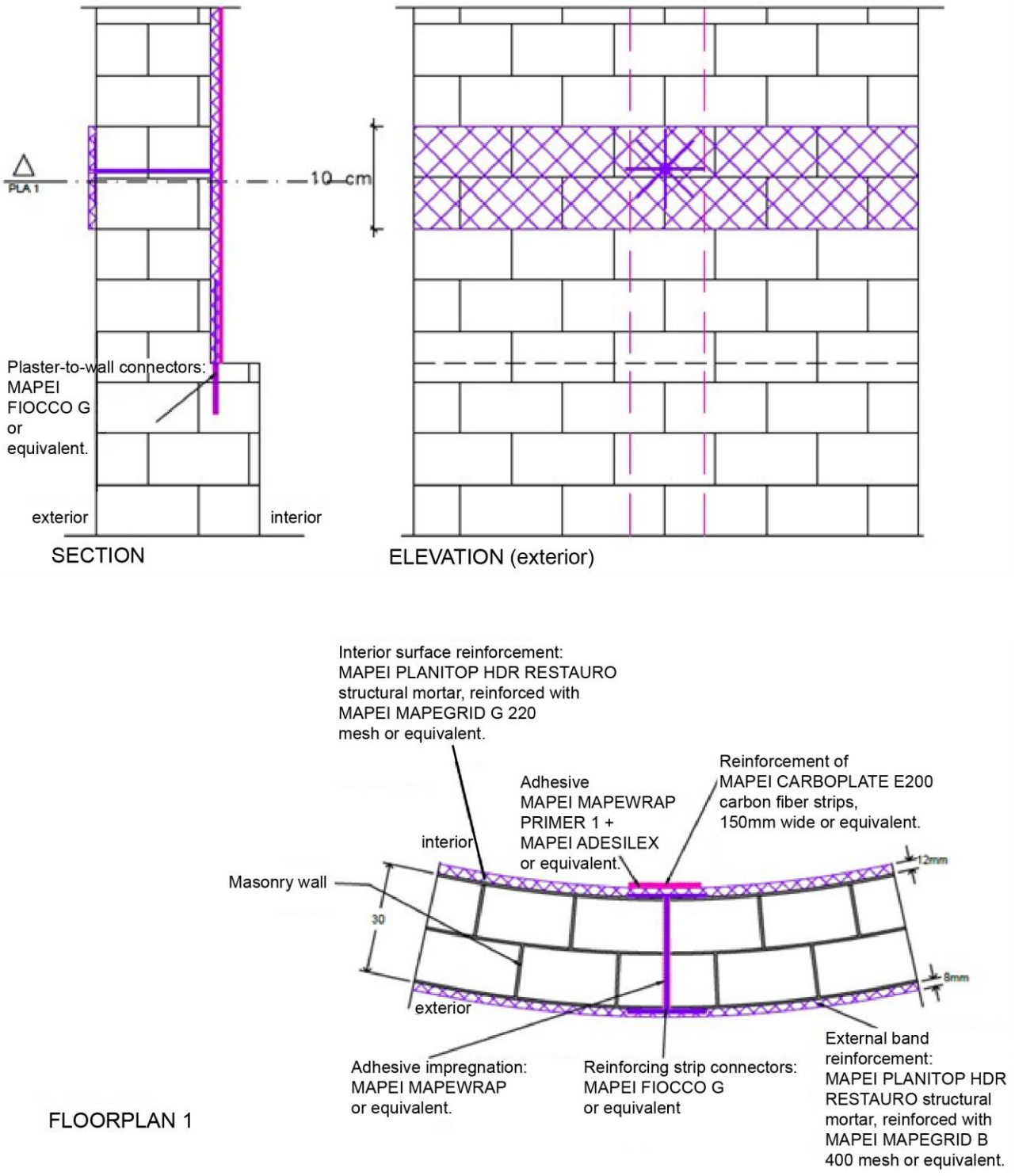

Fig.5-6: Details of rehabilitation of the chimney avoiding the use of steel, to improve durability and reduce future maintenance: *© bisstructures*

- Interior reinforcement using fiber-reinforced mortar and internal fiberglass mesh.
- Surface vertical ribs formed by carbon fiber sheets, adhered to the interior mortar reinforcement.
- Exterior rings of fiber-reinforced mortar and internal basalt fiber mesh, joined to the interior reinforcement by means of unidirectional fiberglass rope type connectors.