The Application of an Innovative Coring Technique in the Medieval Church of Santa Maria Sopra Minerva

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Abstract: - The static reinforcement is consisting by anchorages injected within the thickness of he walls by long perforations with a continuous perforation in order to the introduction of steel bars specifically quith the purpose of improving the statico or dynamic behavior in the seismic action of the existing buildings. To perform coring with this system it is achieved (after various versions) a prototype machine which has, as part propulsive, a high-performance motor with reduced consumption of electric energy which uses, for all the moving parts (including the diamond head), a special cooling system in a closed cycle and a suction system which is also in a closed cycle without dispersions of powders in the environment resulting in greater healthiness of the place of work. In this last conceived and patented system entirely, developed in laboratory, is not used the water but a specific fluid appropriately controlled, that totally eliminating the huge consumption of water usually employed in the perforations, thus avoid the chemical physical phenomena produced by the contact of the water with the mortar of the masonry and thus safeguarding an increasingly valuable resource and essential for life of living beings. This system performs drilling with extreme precision both in direction and in diameter without impact or vibration through stones such as marble, granite, natural stone, concrete and reinforced concrete and all materials normally used in construction without any limit. Designed to perform long perforations for the consolidation of the buildings in elevation it is able to accurately advance also in inhomogeneous materials up to about 25/30 meters in any direction. The diameters for which the system has been studied, in the most frequently used applications, ranging from a minimum of 40mm. To a maximum of 80mm.

Key-Words: - Stones, Perforations, Mortar, Prototype, S. Maria, Minerva, Conservation

1 Introduction

The church of Santa Maria Sopra Minerva, rises in Rome at the end of the thirteenth century, with the opening of the Minerva shipyard. It is considered the largest church in late medieval, Gothic Rome. The configuration of the building is unprecedented because it derives from the meeting of the types of Mendicant orders and from Roman construction in the fourteenth century. Continuing rearrangements until the nineteenth century make it difficult to read. It was originally owned by the nuns of Campo Marzo; fi built in memory of the temple dedicated to Minerva. Under Gregory XI the nuns gave it to the Dominicans, who built a much more imposing church, through the pious works and donations of Cardinal Antonio Barberino. The "grand tribune" was rebuilt by Carlo Maderno, who added the choir. Inside, in the chapels were placed works by famous artists such as Carlo Maderno (Chapel of the Santissima Annunziata), Cesare Nebbia, Ambrogio Buonvicino, Giacomo della Porta, Michelangelo Buonarroti (the Christ of the high altar) and Bernini. A convent with a cloister is annexed to the church, in the past it also housed the court of the ecclesiastical Inquisition, belonging to the Dominican Order, and in which Galileo was condemned. After 1870, expropriated, it became the headquarters, almost as a "compensation", of the Ministry of Education, then the Post Office. Today it is home to the offices of the Chamber of Deputies, including the parliamentary commissions and the library, which is accessed from via the Seminary. To the Domenicani has remained only one of the three large cloisters inside the convent, rebuilt in 1559 on Guidetto Guidetti's architecture, while the fifteenth-century cloister of the Cisterna belongs to the Chamber. The side of the convent along Via di S. Ignazio houses the Casanatense library, donated in 1698 by Cardinal Casanate. The interior is burdened by the rich polychrome decoration, due to the nineteenth-century restorations. The church has

three naves, with cross vaults and subdivided by mixtilinear pillars. The chapels of the side aisles are rich in works of art between the fifteenth and seventeenth centuries. The library, opened in 1725, has a splendid hall designed by Carlo Fontana, and is rich in over 300,000 volumes, specialized in the historical-religious sector, as well as an important collection of Roman subjects. In the Beato Angelico street, behind the church, in 1883 sculptures and a small obelisk were found, Egyptian works of Roman age. In front of the church stands the obelisk Minerveo, a work by Bernini.

Fig.1 S.Maria sopra Minerva, la facciata

2 The intervention

The company that performs the work is the first in Italy to use the stainless steel bar with mortar contained by micro-perforated fabric (Bossong system). In the most delicate and complex jobs it uses the new patented drilling system :

continuous rotation-only drilling with cooling of the reverse circulating diamond tool and direct suction with total recovery of the cooling fluid and the perforated material with automatic cleaning of the hole.

In order to carry out drilling with this system, it has produced (after various versions) a prototype machine that features, as a propulsive part, a high-performance engine with reduced energy consumption that uses a cooling system of all moving parts (including the closed-loop diamond head) and a closed loop suction system without dispersion of dust into the environment with consequent greater salubrity of the work place. In this latest system, conceived and patented entirely in the Diamantech laboratory,

water is not used but a specific fluid suitably controlled, totally eliminating the consumption of water used in drilling, thus avoiding the physical and chemical phenomena produced by the same in contact with the mortars of the masonry and thus safeguarding an increasingly precious and indispensable resource for the life of living beings.

This system drills with extreme precision both in direction and in diameter without percussion or vibrations through stone materials such as marble, granite, natural stone, concrete and reinforced concrete and all the materials normally used in buildings without any limit. Designed to perform long perforations for the consolidation of buildings in elevation it is able to advance with precision even in uneven materials up to about 25/30 meters in any direction.

The diameters for which the system has been studied, used more frequently in applications, range from a minimum of 40mm. At a maximum of 80mm.

The intervention is aimed at connecting the facade to the central body of the nave through very long entanglements that cross the walls of the central nave, in a very small space available; the static reinforcement consists of anchors injected into the thickness of the masonry by means of long continuous core drilling functionalities for the introduction of specific steel bars in order to improve the static or dynamic behavior under the seismic action of the existing buildings The new core drilling system, which is the exclusive patent of Diamantech, provides continuous rotation-only drilling with cooling of the reverse circulating diamond tool of fluids and direct suction with total recovery of the cooling fluid and the perforated material with automatic cleaning of the borehole.

Fig. n.2 Scaffolding on the facade of S. Maria sopra Minerva, photo: S.Coccoli


Fig. n.3 Countdown on the counter-facade,S.Coccoli

4 Conclusion

There was a problem of detaching the facade from the right side with the appearance of the typical crack pattern.

The applications can be the following: Drilling masonry of monumental historical buildings for their structural consolidation as a function of reinforcement, seismic adjustment or static improvement aimed at the insertion of various types of steel reinforcing bars, obtaining a clean, invisible work. sustainable, if necessary reversible without external architectural alterations. Drilling on concrete, including reinforced concrete, for the passage of plants or controlled demolitions in environments where it is not possible to use water as power plants, nuclear powerplants or controlled environments (museums, hospitals, laboratories, banks, military environments, research sites). Drilling in places not supplied with running water suchas: ancient historical sites in isolated locations. Perforations inside walls with precious plasters, paintings, frescoes or which must not undergo chemical physical alterations caused by water, such as ancient buildings, houses, castles, cultural centers, museum environments, churches, or religious buildings in general, portions of buildings inhabited or located in historic centers. In the specialized market, a precise operational methodology is increasingly requested, aiming at the noninvasiveness of the workings and the minimum intervention in order to safeguard the work on which the drilling must be performed. The patented system designed and built responds more exhaustive to this need. Specifically, it was perforated for lengths of up to 24 meters horizontally, proceeding orthogonally to the facade of the church, continuing in the spine walls forming the arches of the side aisles.

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