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Structural Reinforcement of the Cathedral in Cava dei Tirreni

Renforcement structural de la cathédrale de Cava dei Tirreni

Statische Festigung der Kathedrale von Cava dei Tirreni

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1. SUBJECT OF THE INTERVENTION.

The main building of St. Adiutore's Cathedral in Cava dei Tirreni is composed of a large broad nave, two side aisles, a transept and an apseidal area. The construction of the Church, lasted about 55 years, begun in the second decade of the XVI century. However, many subsequent interventions caused during the time a remarkable "static confusion" of the resisting elements which, added to the original high seismic vulnerability of the structure, led to the complete closing of the monument after the Irpinia earthquake of November 23, 1980.

2. DIAGNOSIS OF THE DAMAGES.

The main diseases were: deep fractures in the arches and in the vaults of both the side aisles, compression failure of some masonry pillars and a substantial foundation settlements in a wide zone between the principal facade and the right side aisle.

The masonry buttresses, built to contrast the seismic lateral loads, fulfilled their function during last earthquake event, but disjoined from the bearing walls and plasticized in the cross sections of lowest strength. The principal facade presented dangerous slipping surfaces and disjunction from the aisles walls, and the outbuildings were diffusely damaged. The wooden coverings were in a severely degraded state.

3. SOLUTION ADOPTED.

The proposed intervention therapy, aimed at the reduction of the building seismic vulnerability through retrofitting and strengthening the existing structures.

First of all, with reference to the central nave and the lateral aisles, it was decided to prop the fractured vaults and arches, to demolish the heavy masonry buttresses, and to disassemble the wooden covering.

Retrofitting of the existing masonry structures has been performed by:

- confinement of the damaged masonry pillars, using closed steel plates as stirrups and an external cover of spritz-beton;
- sewing of the arches fractures through insertion of radial steel bars and injection of grouting mortar;
- strengthening of the vaults through superposition of a reinforced concrete slab, connected to the vaults by means of glued steel nails.

The task of contrasting the seismic lateral loads is now performed by reinforced concrete frames effectively shaped, which are much lighter than the demolished tuff buttresses and have a much higher strenght per unit volume. These elements bear the new r.c. pitch roof of the lateral aisle, and allow a complete connection between the pillars-arches complex and the masonry walls of the central nave: r.c. and masonry are linked together by means of steel nails.

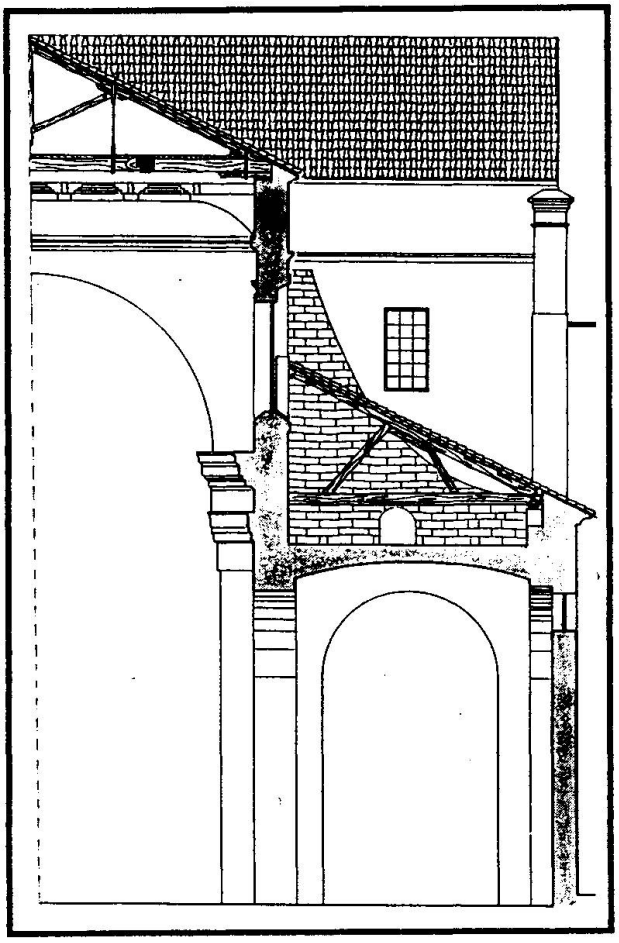

Fig. 1 Cross-section of the right side aisle before structural rehabilitation

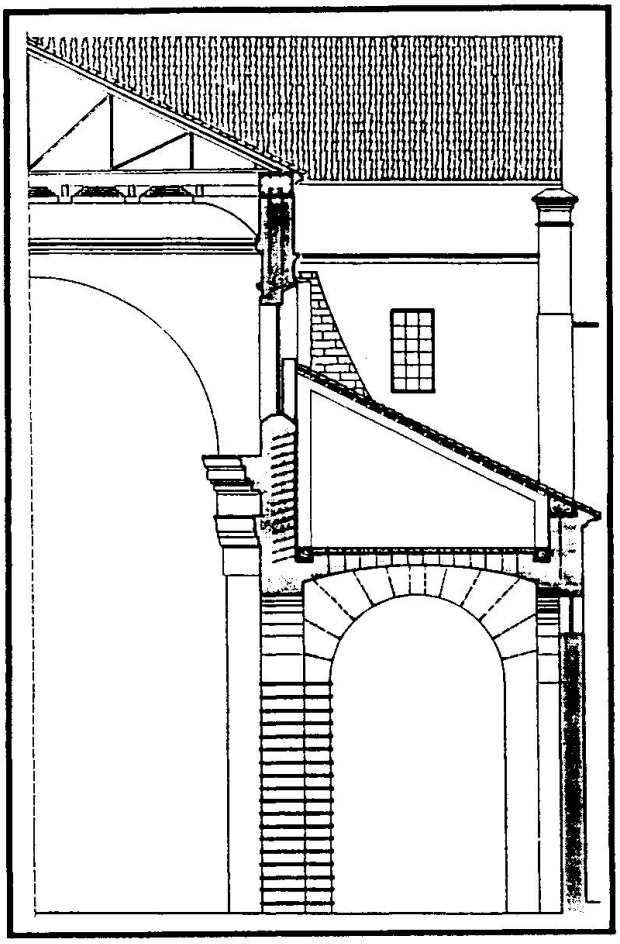

Fig. 2 Cross-section of the right side aisle after structural rehabilitation

A finite element model of the entire system has been developed, assuming that masonry elements are unable to resist tractions. An equivalent linear dynamic analysis has been performed, selecting the design earthquake time histories among the accelerograms recorded in the nearby stations during the Nov. 23, 1980 event. Results show a satisfactory reduction of the seismic vulnerability.

The new roof structures of the central nave consist of steel trusses, which were built assembling with bolts at the Cathedral site shop-welded elements, and then hoisting them onto the r.c. curb built on top of the existing walls.

The static recovery of the monument ended with the strengthening of the principal facade, performed through insertion of vertical and horizontal steel bars.