

A Protected Landmark Monument: Reinforcement, Rehabilitation, and Restoration of the Cathedral Basilica of Manizales

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ABSTRACT

The Cathedral of Manizales is one of the most representative buildings of the so-called "republican architecture", boosted in a remarkable and singular way after the fires of the 1920s in the city of Manizales, Colombia. Its "eclectic neo-gothic" design was made in Paris, after the fire that destroyed the city's previous cathedral in 1926. This masterpiece of Colombian architecture was completed in 2018, ninety years after the first stone was laid in 1928. Its construction was carried out in "reinforced cement"; few decades after the appearance of reinforced concrete. During its ninety years, the cathedral suffered earthquakes of high intensity, in 1938, 1962 and 1979, which have significantly compromised its structure. The earthquake of 1962 produced partial destruction and the collapse of the northwest tower. In 1979, although the cathedral had been repaired, it suffered serious damage to its main structural walls. The temple originally thought as invulnerable was not and demanded to make new structural reinforcements and interventions that were projected twenty years later (1999) and that have been carried out during the two following decades of the new millennium. The departmental government, with the support of the national government, promoted the accomplishing of these earthquake-resistant rehabilitation studies to preserve the temple declared a National Monument in 1984. They were the diagnosis of the structural conditions of seismic vulnerability and how it could be provided a greater capacity of response in terms of stiffness, resistance and dissipation of energy, as well as the diagnosis of the state and pathology of the materials. This included geotechnical studies of seismic amplification, dynamic behavior using environmental vibrations, 3D virtual modeling, and structural analysis, even with finite elements. For the reinforcement, the intervention of the base of the central spire was proposed, the control of the stability of the four corner towers, the construction of new structural walls joined in strategic points; cemented in caissons and connected to each other in the upper level to guarantee the action of the diaphragm and a better seismic behavior of the structure. The interventions to improve the seismic resistance of the cathedral were carried out between 2002 and 2004. The treatment and protection of the concrete and other necessary interventions of its sculptures and images were carried out between 2016 and 2017. A new generation of local specialists would have to study and propose, for this temple of 113 meters high, its seismic reinforcement, the treatment of its materials and other necessary protection interventions, in accordance with the advancement of the state of the art of earthquake engineering, design and construction of structures reinforced concrete and the protection of historical heritage.

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