

## Techniques for Seismic Strengthening of Historical Monuments from Diagnosis to Implementation

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**Abstract :** A multi-disciplinary approach is required in any intervention project for historical monuments. Due to the complexity of their geometry, the variable and unpredictable characteristics of original materials used in their creation, heritage structures are peculiar. Their histories are often complex, and they require correct diagnoses to decide on the techniques of intervention. This approach should not only combine technical aspects but also historical research that may help discover phenomena involving structural issues, and acquire a knowledge of the structure on its concept, method of construction, previous interventions, process of damage, and its current state. In addition to the traditional techniques like bed joint reinforcement, the repairing, strengthening and restoration of historical buildings may require several other modern methods which may be described as innovative techniques like pre-stressing and post-tensioning, use of shape memory alloy devices and shock transmission units, shoring, drilling, and the use of stainless steel or titanium. Regardless of the method to be incorporated in the strengthening process, which can be traditional or innovative, it is crucial to recognize that structural strengthening is the process of upgrading the structural system of the existing building with the aim of improving its performance under existing and additional loads like seismic loads. This process is much more complex than dealing with a new construction, owing to the fact that there are several unknown factors associated with the structural system. Material properties, load paths, previous interventions, existing reinforcement are especially important matters to be considered. There are several examples of seismic strengthening with traditional and innovative techniques around the world, which will be discussed in this paper in detail, including their pros and cons. Ultimately, however, the main idea underlying the philosophy of a successful intervention with the most appropriate techniques of strengthening a historic monument should be decided by a proper assessment of the specific needs of the building.

**Keywords :** bed joint reinforcement, historical monuments, post-tensioning, pre-stressing, seismic strengthening, shape memory alloy devices, shock transmitters, tie rods

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