Retrofitting of Heritage Structures
Design and evaluation of strengthening techniques
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Preface

The preservation of heritage architecture is a cultural objective rigorously pursued by communities and nations wishing to promote their history, civilisation and aesthetic achievements. Structures built in the remote past by traditional methods have suffered the consequences of extreme loading events, such as earthquakes, over long time periods. Retrofitting is an approach based on recent technological developments and scientific knowledge, whereby modern construction methods and materials are applied to the repair and strengthening of historical structures. This book, based on an edited collection of articles from the Transactions of the Wessex Institute, aims to inform on current retrofitting techniques, their application to various types of historical architecture and their effectiveness to fulfil their purpose.

The adoption of particular retrofitting techniques depends on the type and size of the structure to be preserved as well as the conditions it is protected from. Structural forms vary widely from age old places of worship, such as churches, mosques and temples, as well as castles and palaces to more modern, distinguished private residences or public buildings, some of them designed by well known architects. The methods of constructions range from traditional, such as stone or brick masonry to more recent textile block systems and reinforced concrete frameworks.

A detailed visual inspection of a damaged structure provides a valuable insight into possible causes of failure; these are often attributed not only to inadequate strength of the original construction but also to subsequent not well thought attempts to strengthen it. Testing samples extracted from the existing structure leads to material characterisation which is essential to modelling for performance assessment. The behaviour of the structure before and after retrofitting can be assessed by numerical analysis usually based on general purpose finite element packages. The analysis of the original structure informs on its existing strength and weaknesses and assists the prospective retrofitting plan and design. The analysis of a structure strengthened by either conceptual or actual retrofitting serves as an evaluation of the effectiveness of the proposed or taken measures.
Strengthening techniques for masonry walls include re-pointing, injection grouting and the use of steel ties. Reinforced concrete is used in the form of cast-in-place walls, jackets around column or beams or tie-beams at floor and foundation levels; carbon fiber reinforced laminates can be used for reinforcing walls and slabs. Innovative use of materials, such as shape memory alloys, self-compacting concrete or thin lead layers is also suggested.

Earthquakes arguably constitute the most damaging external action and most of the research reported in the book focuses on methods to moderate their consequences. Seismic energy absorbing devices and base isolation systems are two effective means of providing protection against future seismic events although their application is often met with many technical challenges in practice. This book addresses, to a certain extent, all the above issues; it is thus expected to make an important and topical contribution to the body of knowledge in this area.

Stavros Syngellakis

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