Persian Architectural Heritage

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To Persian architectural heritage

to the blessed memory of Mustafa Hejazi
to the blessed memory of Gh. Mehdizadeh

and to our beloved ones Ashraf, Farideh, Bina and Saba
and Masoud, Erfan, Amir-Mohammad Taghvaei and Tahereh
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For those like me whose knowledge of architecture and structural form has been rooted in the Hellenistic-Roman traditions, the discovery of Persian Architecture was a revelation.

This happened when I became acquainted with the work of my friend and colleague, Mehrdad Hejazi, the first author of this book through reading his book “Historical Buildings of Iran: their Architecture and Structure” also published a few years ago by our academic press; a book written by somebody like Mehrdad with knowledge of the material required and who was motivated by a deep love for his cultural heritage as well as an appreciation of European cultural values. This led me to read other books on Persian historical architecture to gain a better understanding of its influence and the awareness that a definitive work was needed to provide a fuller, more comprehensive picture.

The task was immense due to the complexity of the subject and long time periods involved. Mehrdad, however, undertook the challenge with his customary care and thoroughness; the final result being this unique book. The more I read about Persian heritage, the better I understood the difficulties faced by Mehrdad!

The geographical area influenced by Persian culture is in itself huge and many different historical periods confronted the author. The structures themselves were as varied as religious buildings and palaces or bridges; caravanserais and fortifications. In spite of this variety, the author conveys the special character and continuity of Persian architectural forms.

There is something unique about Persian architecture that has led to the development of light and beautiful forms in the midst of harsh and bare surroundings, embodying an attempt to succeed to reach the sky in spite of adversity. Take, for example, the development of the arch and the vault. The intersection of two vaults produced the groined vault and the rotation of the arch around its vertical axis led to the dome.

The development of the dome in Persian architecture is in itself an inexhaustible topic. Their most striking features are lightness and beauty. Their design progressed from being supported on cylindrical walls to more efficient and pleasing structures as leading to circular domes being supported on square bases. The transition from a square to a circular plan invented by the Persians consisted in adding arches and small domes in the corners. This most beautiful device gave rise to a distinctive Islamic architecture that has spread all over the world. Later on, the vaults and domes were decorated using the so-called stalactites, ornamental additions enhancing that lightness.

Persian architecture while not immune to external influences has not been dominated by them. The Hellenistic culture period following Alexander’s defeat of Darius led to some Hellenistic elements being added, particularly in certain regions, but the overall effect was small and it cannot be
compared with the influence that masterpieces such as Persepolis continued to have on surrounding countries, even after its wanton destruction by the conquerors. The Persian influence in Greek architecture is obvious.

Similarly, other invaders failed to make an enduring impact on the character of Persian architecture – what Alexander could not do, other conquerors such as the Seljuk and the Mongols and even the feared Tamerlane also found impossible. The converse is true as, after a period of conquest and destruction, the conquerors became the most committed builders, succumbing to the charms of Persian architecture and leaving behind some outstanding buildings.

It was only the Romans, as the defeated rather than as the conquerors, who left behind an architectural legacy that was based on practical engineering. When many Roman prisoners were taken after the defeat of Valerian, they built many bridges, dams and roads, topics outside the scope of this book.

Yet, Persian engineering has something special to teach us not only through the study of its most conspicuous structural form but also from most common but equally important examples. The development of the Qanat, those extraordinary underground canals, is most pertinent to a world threatened by the depletion of its water resources. Domestic architecture including pools, water channels, basement rooms and wind towers offer us valuable lessons in sustainability.

Hence, it is with a feeling of humility that I accepted the invitation to write this foreword. By doing so, I wanted not only to congratulate him and his co-author for their excellent book but also have an opportunity to express my gratitude to Mehrdad for having led me, through his friendship, to achieve a better understanding of Persian culture and architecture.

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PREFACE

The distinctive characteristics of Persian architecture and contribution of Persian culture to the foundations of human civilisation have been the focus of many experts from all over the world during the past decades.

The book *Historical Buildings of Iran: their Architecture and Structure*, written by the first author of the present book and published by WIT Press in 1997, is the first book that has studied historical buildings of Iran through a structural engineering approach. New information about knowledge used in Persian architectural heritage and methodologies for its preservation have been provided by scientific researches since then; this has urged the authors to prepare a series of three books to fulfil new demands in the subject of Persian architecture. The books are titled: *Persian Architectural Heritage: Architecture*, *Persian Architectural Heritage: Structure*, and *Persian Architectural Heritage: Conservation*. These books aim to give comprehensive information about Persian architectural heritage to scholars, students and practicing engineers in civil, structural, architectural, hydraulic and restoration engineering and other related disciplines. It is the first series of books in this field that studies Persian architectural heritage from architectural, structural and conservation viewpoints. The books are not only reference works but they also contain theory and are written in such a way that appeals to practicing engineers as well as students and researchers.

The present book, the second in the series, consists of seven chapters. The opening chapter of the book reviews the literature on structural research into Persian architectural heritage. In Chapter 2, construction materials of architectural heritage structures, including stone, earthen materials and adobe, brick and mortar, and mechanical properties of masonry, wood and metal are dealt with. Construction technology of traditional adobe, brick, stone and wooden structures is introduced in Chapter 3. This chapter presents details and different types of foundations, walls, roofs, anti-earthquake elements, arches and vaults. Chapter 4 describes structural analysis of architectural heritage, including plastic analysis or limit analysis, the finite element method, failure criteria, modelling of unit–mortar interface, the finite difference method, the boundary element method, the discrete element method and remarks on the analysis of historical masonry structures. Masonry arches, thrust of arches, thickness of the arches, necessity of buttresses, the shape of arches, failure in arches, arch and earthquakes, repair of arches, arch profiles in Persian architecture, effects of bricklaying methods on structural behaviour and optimum shapes of Persian arches are treated in Chapter 5. Chapter 6 includes construction methods and structural systems of Persian vaults, the effect of variation of thickness on the stability of barrel vaults, the structural function of ribs in cross
vaults and damage in vaults. Geometry, construction methods, substructure and corner construction, types and structural analysis of Persian domes as well as plastic analysis of spherical domes are presented in Chapter 7.

Deep appreciation and gratitude are extended to Dr Carlos Alberto Brebbia, professor of Computational Mechanics and the director of the Wessex Institute of Technology, Ashurst Lodge, Ashurst, UK, who proposed and supported the publication of the book; Dr Paulo B. Lourenço, professor of Structural Engineering, Department of Civil Engineering, University of Minho, Guimarães, Portugal, who granted permission for using some parts of his works in Chapters 2 and 4; and the staff members of WIT Press, in particular Ms Elizabeth Cherry and Mr David Anderson, for their ceaseless help and encouragement in the production of this book.

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