Drone-Assisted Inspection of Bridges and Heritage Structures

Case Studies, Methodologies, and Risk Prevention Perspectives

Dr. Rubén Rodríguez Elizalde

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DRONE-ASSISTED INSPECTION OF BRIDGES AND HERITAGE STRUCTURES: CASE STUDIES, METHODOLOGIES, AND RISK PREVENTION PERSPECTIVES

Rubén Rodríguez Elizalde

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Part I – Theoretical Foundations and Methodological Evolution

The first part of this work establishes the conceptual and technical framework that supports the application of drones in infrastructure inspection, with particular emphasis on bridges and historical structures. Through a sequence of introductory chapters, it explores the origins of the author's research trajectory, the evolution of structural assessment methodologies, and the emerging role of Remotely Piloted Aircraft Systems (RPAS) in this field.

Here, the reader will find a cross-disciplinary perspective that connects traditionally separate domains: civil engineering, heritage conservation, occupational risk prevention, and emerging technologies applied to diagnostics. The historical development of inspection techniques is reviewed—from manual methods to the use of remote sensors—and the main advantages and limitations of RPAS compared to traditional approaches are introduced.

This section also delves into the legal, ethical, and environmental aspects related to drone usage in sensitive contexts. It emphasizes the importance of operating within well-defined legal frameworks, minimizing physical impact on heritage assets and their surroundings, and aligning technological innovation with principles of sustainability and social responsibility.

In doing so, it not only contextualizes the book’s methodological approach, but also provides readers with a solid foundation for understanding the technical perspective that will guide the remainder of the work.

1. Personal Motivation and Development of the Research Line

This book stems from the convergence of traditional construction knowledge and the transformative potential of technology. Its author, Dr. Rubén Rodríguez Elizalde, has spent the last several years conducting intensive research at the intersection of architectural heritage conservation, technological innovation, and occupational risk prevention. This line of work is not the result of a passing trend but the outcome of a sustained academic path, where an admiration for historical

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This book offers a comprehensive and multidisciplinary analysis of the use of Remotely Piloted Aircraft Systems (RPAS), or drones, in the inspection of bridges and heritage structures. It integrates structural engineering, heritage conservation, and occupational risk prevention, presenting both theoretical foundations and practical applications. The work explores the evolution of inspection methods, the advantages and limitations of drone technologies, and their legal, ethical, and environmental implications. It provides detailed guidance on flight planning, sensor selection, and data acquisition, and examines the integration of drone-generated data into BIM models and digital twins. Featuring more than sixty technical illustrations and multiple case studies—including historic and submerged structures—the book demonstrates how RPAS enhance diagnostic precision, reduce risk, and support sustainable, non-invasive conservation strategies.

Dr. Rubén Rodríguez Elizalde

Dr. Rubén Rodríguez Elizalde is a structural engineer and professor at the Universitat Oberta de Catalunya (UOC), where he directs the Master in Occupational Risk Prevention program. He holds a PhD in Architecture and Heritage and has over 20 years of experience in structural pathology, rehabilitation, and the conservation of historical structures.

His research bridges drone-based inspection, structural engineering, heritage conservation, and occupational risk prevention. He has led inspection and diagnostic campaigns on highly significant monuments using non-invasive auscultation techniques—including aerial photogrammetry, thermography, and underwater drones—to document and assess inaccessible elements. In parallel, he has conducted studies on accident rates and risk patterns in particularly hazardous work environments, contributing to the development of safer protocols and preventive strategies.

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