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## **Challenges of a Multiple Super-long Span Suspension Bridge Crossing of the Irish Sea**

**Ian Firth**

[ian@ianfirth.com](mailto:ian@ianfirth.com)

Consultant, COWI UK

Chris Walker, Cameron Archer-Jones & Andrew Mountjoy COWI UK

### **ABSTRACT**

Constructing a 36km long bridge across the North Channel of the Irish Sea between Scotland and Northern Ireland in water up to 300m deep presents several substantial challenges. In March 2021, the authors were assigned the task of establishing whether such a crossing is feasible, as part of the UK Government's review of the connectivity between the four parts of the United Kingdom.

The technical challenges are enormous and focus principally on constructing the substructures and foundations in very deep water, the main cable design and erection, the severe environmental conditions and many operational factors. The solutions that emerged from the high-level study included a suspension bridge carrying twin railway tracks and dual three-lane carriageways on a multiple steel box girder deck structure, with seven spans of 3750m supported on eight pylons rising to a height of nearly 550m above sea level. Similar concepts have been developed by COWI previously for the Gibraltar Strait Crossing and the Yemen-Djibouti Crossing, and this study was able to draw on lessons learnt from that earlier work.

This paper describes the evolution of the preferred structural solution and focusses on the complex technical issues which set this project apart from any other long span bridge solution, including the deep water foundations and the design and construction of the main cables. It concludes with a discussion of the key risks and some lessons learnt for the design of such enormous structures in future.

**Keywords:** Multi-span, suspension bridge, deep-water crossing.

### **1 INTRODUCTION**

The question of whether it is technically possible to construct a bridge crossing of the Irish Sea arose as part of a wider study undertaken by the UK Government in 2021 which considered all aspects of connectivity between the four nations of the United Kingdom. The short, high-level study was not required to identify the optimum or lowest cost solution; such questions were to be for a future phase of investigation. The study area was wide and included the whole of the northern Irish Sea, and not just the shortest route from Scotland to Northern Ireland across the North Channel.

A family of options were evaluated, including tunnel and bridge crossings, taking into account not only the crossing itself but also the many complex challenges of upgrading or building new connecting railway and highway infrastructure on both sides. The optimum route for the bridge crossing option was determined to be between the Rhins of Galloway in Scotland and the coast of