Introduction

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Welcome to the May 2018 special issue of *Civil Engineering* on major and innovative projects in the Nordic Countries – which are Denmark, Faroe Islands, Finland, Greenland, Iceland, Norway and Sweden. These technologically advanced north-western European states share the challenges of colder climates, difficult terrain and large inter-urban distances, together with opportunities for sustainable growth and regeneration in major towns and cities. This in turn has inspired innovative infrastructure solutions.

Hulgaard and Søndergaard (2018) start by describing a novel waste-to-energy project in Copenhagen, Denmark. The Amager Bakke facility, the largest project of its kind in Scandinavia, combines ultra-high energy efficiency and environmental performance. Care has been taken to integrate the project into the city, both in terms of appearance and by providing public recreation facilities on the roof.

Continuing the energy theme, Moe (2018) reports on an innovative cooling plant at Oslo airport. It uses snow cleared from the runways during winter to help cool the recently enlarged airport terminal buildings in the summer. The plant worked satisfactorily in 2016 and 2017 and is expected to improve following optimisation of snow storage.

From air transport we move to road and rail, with Pedersen and Brøndum (2018) describing the concept design for the Fehmarnbelt fixed link between Denmark and Germany. Due to open in 2028, this €7 billion mega-project is an 18 km long immersed tube tunnel with a four-lane motorway and a two-track railway. Demanding requirements from the owner for availability, maintainability and safety have led to a number of innovative design solutions.

On a somewhat smaller scale, Samuelson and Grøv (2018) then cover two new subsea tunnels being built in the Faroe Islands. There are already 20 road tunnels in the islands which, together with hydropower tunnels, equate to about 1.5 m of tunnel for every inhabitant. The majority of these economically vital tunnels are in basalt and constructed using drill and blast.

Staying underground, Andersen *et al.* (2018) describe the four-track Holmestrand railway station, believed to be the first high-speed rail station constructed in rock. Keeping waiting passengers safe from the noise and aerodynamic effects of 250 km/h through trains required complex modelling and installation of noise barriers, acoustic ceilings, relief tunnels and pressure doors.

Back in Copenhagen, Falbe-Hansen *et al.* (2018) describe the extensive monitoring of existing structures undertaken as part of the construction of the new Cityringen Metro. The project, comprising 15.5 km of twin bored tunnels, 17 stations and five shafts, passes under the dense urban area of the city centre including many sensitive heritage sites. It is due to open in 2019.

Bergen in Norway has opted for a light rail transport solution, stage 3 of which is described by Sherry (2018). Completed in 2017, the newly opened 7.8 km section was designed by a project

team spread across seven countries using a fully integrated three-dimensional building information model.

In the final paper, Stenman *et al.* (2018) describe design and construction of the €1.8 billion European Spallation Source at Lund in Sweden. Due for completion in 2023, this ‘big science’ project is a neutron source which will allow investigation at molecular level in a number of scientific fields. The project entails complex coordination of end-user and regulatory requirements in terms of structural performance, radiation safety and integration of large bespoke specialist scientific equipment.

We would like to thank all those who helped produce this issue, especially the authors for sharing their knowledge and experience. We hope that you find the papers enjoyable and informative and that they encourage you and your colleagues to consider sharing your own experiences through this and other ICE Proceedings journals.

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