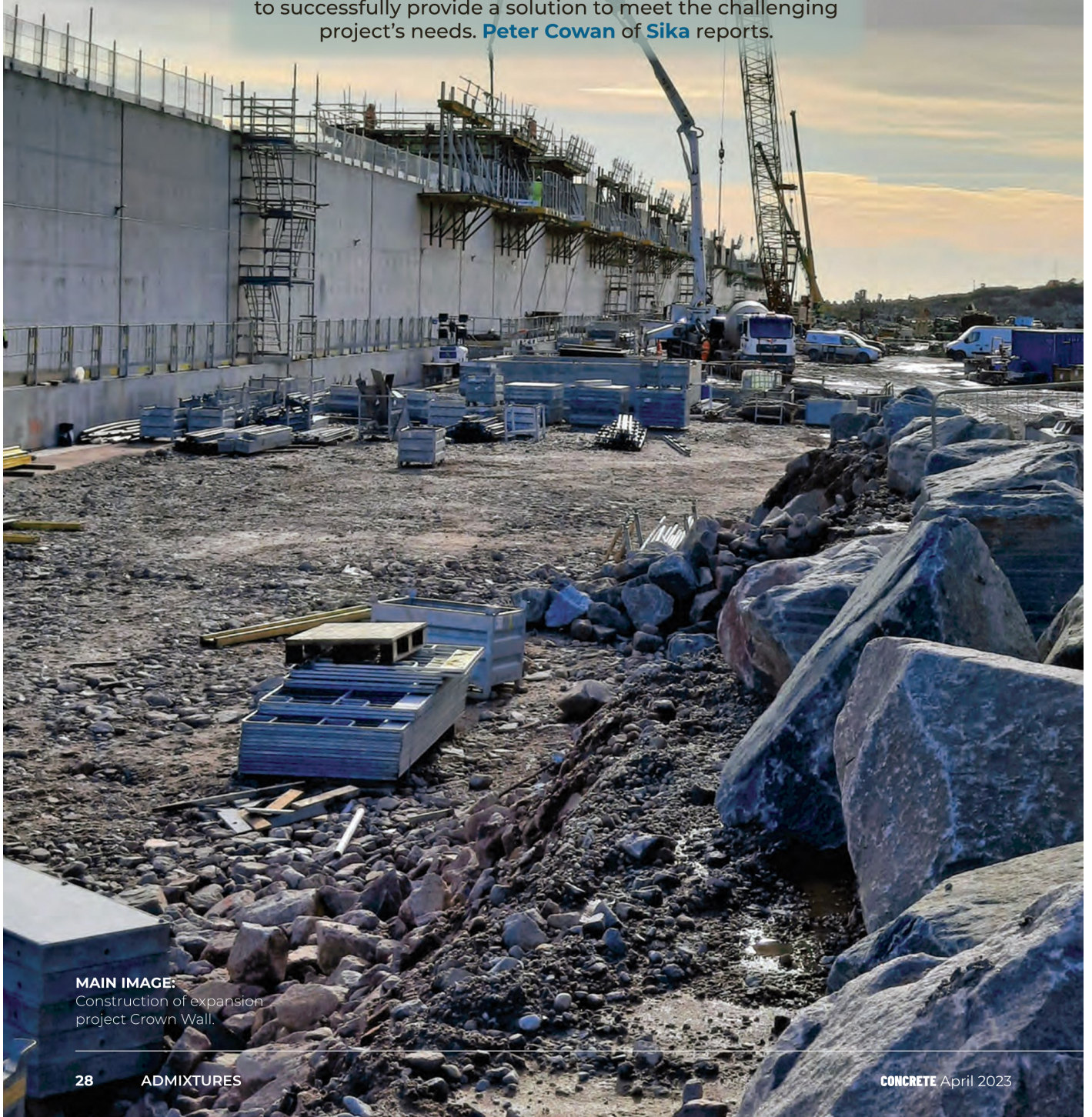


Aberdeen Harbour Expansion Project

Northern Quarry Products – a joint venture between Breedon and Leiths – took on the design, production and supply of ready-mixed concrete for the £400 million Aberdeen Harbour Expansion Project over an 18-month period. Using a variety of admixtures, the company was able to successfully provide a solution to meet the challenging project's needs. **Peter Cowan** of **Sika** reports.



MAIN IMAGE:
Construction of expansion project Crown Wall.



“The Aberdeen Harbour Expansion Project will be one of Europe’s largest greenfield port capital investment projects over the next two decades.”

Established in 1136, Aberdeen Harbour is Britain’s oldest existing business. Today, it is a marine support centre for the subsea engineering sector and oil and gas industry, and main commercial port serving the north-east of Scotland.

The Aberdeen Harbour Expansion Project is a £400 million development of infrastructure to increase the South Harbour’s berthage, offer deeper and stronger quays, and significantly increase its laydown area in order to handle larger vessels.

TRANSFORM

The largest marine infrastructure project in the UK, the works were designed to transform the marine support capacity of Aberdeen through the creation of two new breakwaters, each 600m long, 1.5km of deep-water quay and over 125,000m² of quayside laydown area. The new combined harbour will become Scotland’s largest port in terms of berthage (with the ability to accommodate vessels up to 300m in length) and offer significant new growth opportunities for the area. The Aberdeen Harbour Expansion Project will be one of Europe’s largest

greenfield port capital investment projects over the next two decades.

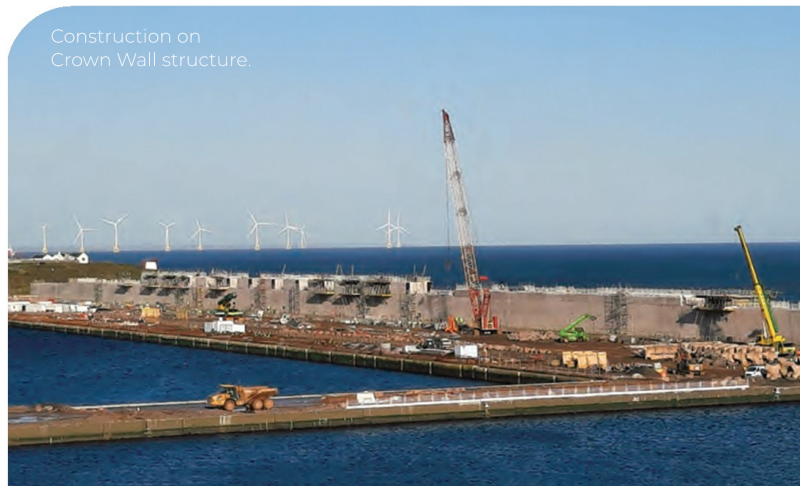
Starting in 2017 and completed in late 2022, the project required 120,000m³ of concrete in total. During 2019, two of Scotland’s construction materials companies, Breedon GB Materials and Leiths Scotland, joined forces to form a joint venture, Northern Quarry Products (NQP), to take on the design, production and supply of ready-mixed concrete to the project over an 18-month period.

It was clear the extent of the supply contract was significant to a point where it would challenge any single supplier. Therefore, both Leiths and Breedon GB Materials showcased the benefits of pulling on the resources and expertise of both companies to enable the challenging technical and supply requirements of the contract to be met.

With tight specifications for the required mixes, NQP contacted Sika and the business was subsequently appointed as main admixture supplier. Sika collaborated and assisted with developing concretes



ABOVE:
Casting of the accropode units.



Construction on Crown Wall structure.

to meet the requirements of low heat of hydration and high early strength development to support in fast-tracking the construction programme. All sand and aggregates for concrete production were sourced from local quarries operated by the JV parent companies.

An 80m³ per hour on-site batching plant was commissioned for the project to provide large volumes of concrete in pour sizes up to 800m³ for the construction of the Crown Wall. The Crown Wall structure is over 620m long, 7m wide and averages 10m high. This accounted for 45km³ of high-strength concrete using high-range water-reducing (HRWR)/superplasticising admixture, Sika ViscoFlow 1100 and a liquid admixture to increase the strength and durability, Sika Plastiment-190, and was completed in seven months.

The quayside was formed with 22 precast concrete caissons approximately 50m long, 12–14m wide and 15m high, weighing 8000 tonnes. The caissons were manufactured in La Coruña in Spain and transported by sea to a storage site in the Cromarty Firth before being towed to the harbour and moved into position by a specialist contractor to form the quayside. There was also the requirement for underwater concrete to infill sections between the caissons, which were subject to tidal waters.

UNDERWATER SOLUTION

NQP used Sika UCS Pak, a powdered underwater/anti-washout admixture, formulated to increase the cohesion of concrete, for underwater elements of the construction. The product produced a thixotropic mix, preventing washout of cement paste under water, allowing for the production and improvement of concrete to be placed underwater.

Designed specifically for marine construction and underwater applications, the product offers a strong increase in cohesion, extended consistence, superior anti-washout properties, less segregation and bleed, and comes packaged in water-soluble bags for easy dispensing.

Laboratory trials were carried out by Breedon GB Materials as part of the collaboration to arrive at the correct dosage for the project.

STRENGTHENING

For the Harbour's Crown Wall, ViscoFlow 1100 was used together with Plastiment-190.

The selection of the superplasticiser was due to its capability of producing high consistence concretes and low water:cement ratio, also improving the speed of application. However, the water-reducing admixture produces a more uniformly cohesive concrete and offers water reduction, resulting in higher density, higher strength and reduced permeability, as well as reduced shrinkage during curing. Together, the admixtures fitted the brief that NQP needed to work to and were robust enough for the task of strengthening the Crown Wall.

ABERDEEN'S ACCROPODES

The project had a requirement for 25,000m³ of a specialist precast concrete with a strength of 12MPa at 24 hours and 30MPa at 48 hours, for the manufacture, handling and demoulding of over 4000 'accropode' units. These accropodes were manufactured in a purpose-built precast facility on-site, which produced 8m³, 12m³ and 16m³ accropode units. This facility was the only one in the world capable of producing 16m³ accropodes.

NQP carried out extensive site trials in collaboration with Sika to

assess early strength development and concrete placement. The mix specification required the use of cement replacements to generate low heat to prevent thermal cracking and achieve high early strength. This was necessary to allow for the stripping and handling of the accropodes to assist daily production cycles.

Concrete for each accropode was pumped over 100m using a static pump at the factory that contained an intricate line with a series of bends and changes in direction. Site and production trials concluded that using the HRWR/superplasticiser Sika ViscoCrete-367 PC, and also Plastiment-190, produced a concrete that met the site requirements.

Again, time was of the essence for this specific element of the project with the design team needing to achieve 20MPa in under 24 hours. The HRWR admixture was able to accomplish this and provided robust strength for the accropodes.

Concrete was supplied from the JV companies' off-site local concrete plants in the south Aberdeen area, with supply completed in six months.

All the accropode units were used to create the South Breakwater to protect the new harbour from the northerly winds of the North Sea and the accropodes were also placed behind the Crown Wall to offer protection from the North Sea.

Concrete supply to the Aberdeen Harbour Expansion Project has faced many challenges, particularly with the demand for cement and GGBS during construction. Working with a local supplier in Northern Quarry Products, with its resources and technical support, ensured that these difficulties were tackled head-on, with teams continuing to deliver large volumes of high-spec concrete during challenging times. **C**

BELOW:

Crown Wall and accropodes.

