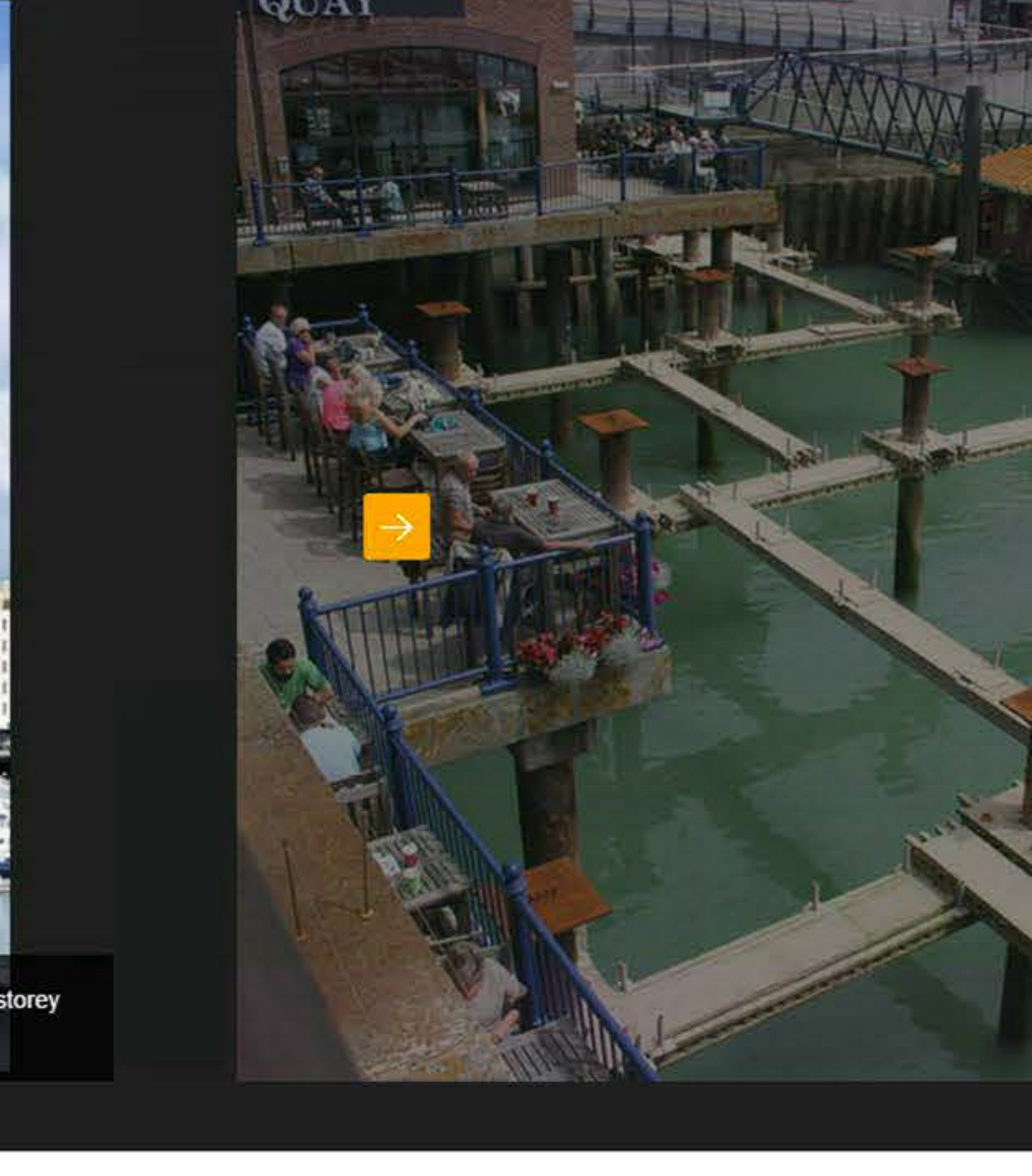
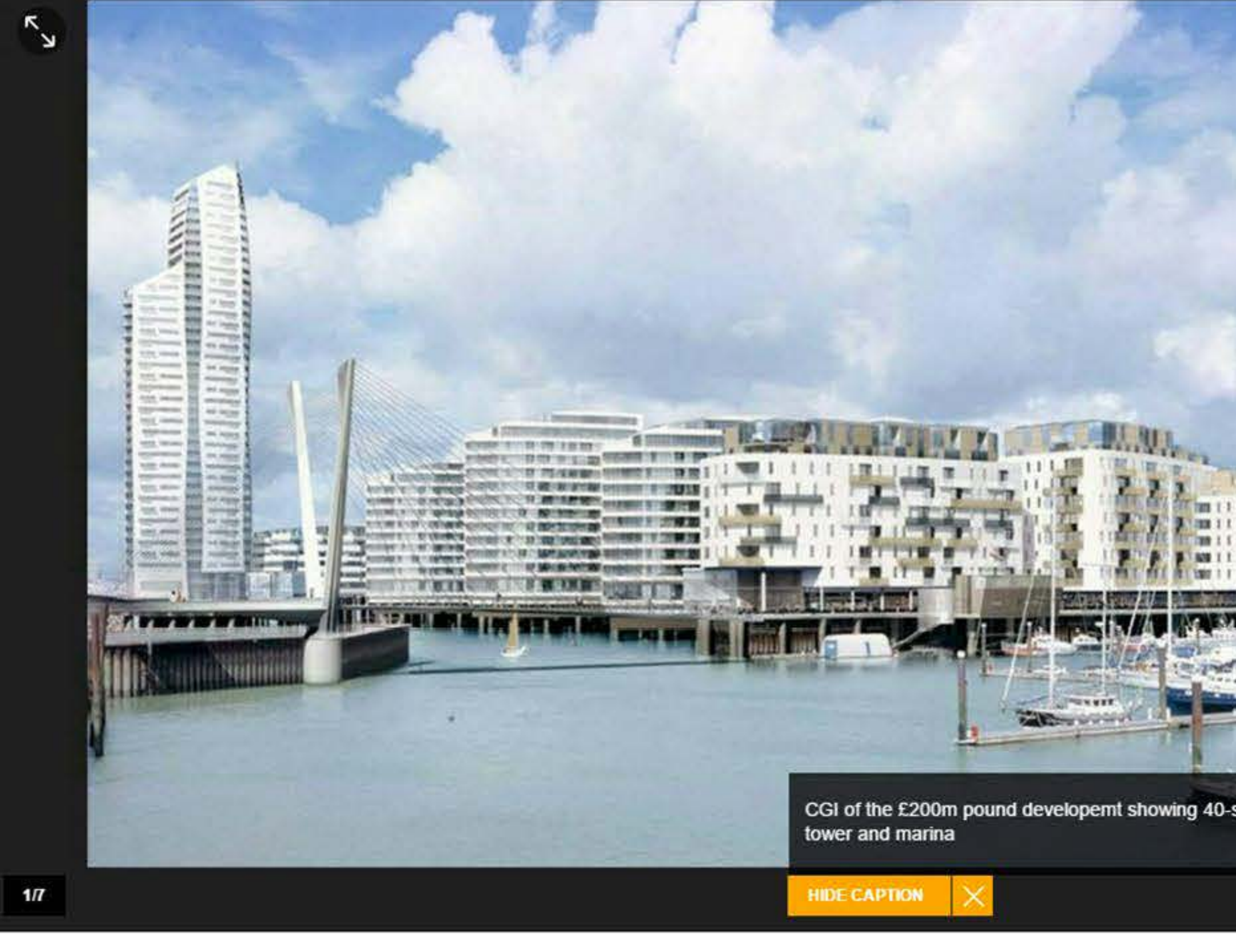


PROJECT REPORTS

Underwater car park calls for expert engineering and Dutch know-how

10 SEPTEMBER, 2014 | BY RUBY KITCHING



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JRL Midgard's submerged site is carefully laying the foundations for the £200m regeneration of Brighton Marina.

- Waterfront goes upmarket
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Project West Quay Development, Brighton Marina

Phase one cost £41.5m

Client West Quay Development Company Partnership, part of Brunswick Development Group

Main contractor JRL Midgard

Structural engineer Meinhardt

Piling contractor Sterk

Concept architect Wilkinson Eyre

While organic juice bars, vintage clothes shops and nightclubs dominate the lively seaside town of Brighton, the mood is much more contemplative at nearby Brighton Marina, where restaurants and an attractive boardwalk overlook up to 1,600 yachts gently rocking in the harbour's still waters.

Brighton Marina is one of the largest in Europe and, soon after opening in 1978, was the catalyst for retail and residential development.

In more recent years, however, the area has lost some of its prestige due to the hulking masses of a new leisure complex and a nine-storey car park dominating the scene to the west.

Coming to the marina's rescue is a £200m regeneration, beginning with phase one: the £41.5m West Quay Development.

Waterfront goes upmarket

This seeks to establish a new, higher-spec waterfront that will screen off the leisure complex's garish casino and McDonald's fast food restaurant. Construction began in January this year.

Main contractor JRL Midgard won the job from client West Quay Developments, part of Brunswick Developments, with Meinhardt securing the structural engineering package.

"This is the last part of this end of the marina to be regenerated," Brunswick Developments senior consultant Peter Green explains.

"The area started being developed in the 1970s and a 2002 planning submission was turned down in 2004. It was resubmitted in 2006 with fewer tall buildings."

This 2006 project comprises two accommodation blocks up to nine storeys tall over a triple-storey basement car park for 350 cars, which will serve subsequent phases of the development. It will provide 195 apartments above 2,787 sq m of ground-floor retail space.

Basement beneath the waves

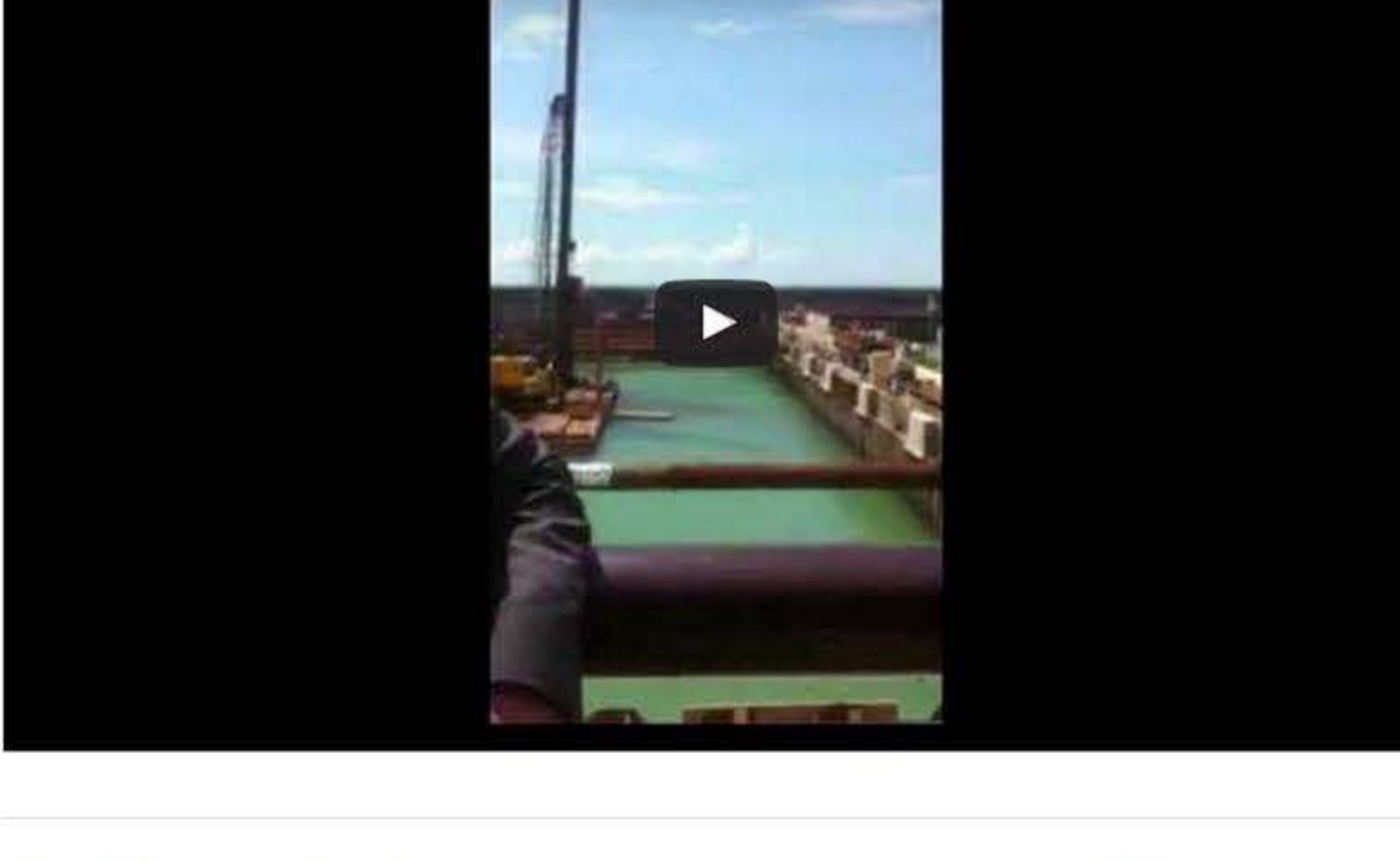
Described like this, the project is fairly run-of-the-mill. But from an engineering point of view, it is much more remarkable, as the structure is being built on the seabed and its triple basement will be permanently submerged.

"We're driving a sheet pile cofferdam 35 m wide and 135 m long for the basement, which effectively becomes the footprint of the new building"

Kevin Keegan, Midgard

A sheet-piled cofferdam will initially form the 'tank' within which the basement will be constructed.

"The interesting thing about this project is that we are building almost entirely on reclaimed land," Midgard managing director Kevin Keegan says.



"We're driving a sheet pile cofferdam 35 m wide and 135 m long [for the basement], which effectively becomes the footprint of the new building."

Dutch piling contractor Sterk is carrying out all of the piling, having had extensive experience of this type of work in the Netherlands.

The West Quay Development runs north-south along the western edge of an existing pier wall, known as the West Quay.

Three sides of the cofferdam have already been constructed using sheet piles, while the fourth side on the development's eastern elevation is provided by this existing quay wall.

The height of this quay wall will eventually be built up to match the height of the sheet piles and, accordingly, the ground floor level of the new development. A lifeboat station which was previously located on the quay wall will also be rebuilt.

Marine piling

A northern promenade deck connects the West Quay Development back to the mainland and will be built on tubular steel marine piles outside the cofferdam. Decking also extends to the south of the development, out into the marina, again supported by marine piles.

Further tubular steel bearing piles installed within the cofferdam will support a basement raft slab for the development.

Sterk was installing the last of the 863 bearing piles and welding the clutches of the sheet piles for the cofferdam when *Construction News* visited the site, having already installed marine piles outside the cofferdam.

The construction sequence has involved Sterk initially installing 73 tubular steel marine piles up to 27 m long and measuring 454 mm in diameter from barge-mounted pile drivers north and then south of the main development.

To construct the deck over these piles, the method has involved welding a plate to the top of them before lowering 6 m-long semi-precast beams – precast concrete troughs complete with reinforcement, which will require in situ concrete infilling later.

The system has been used to reduce the weight of the beams being lowered and to speed up construction. Precast slabs 225 mm deep are then placed on top, followed by a 225 mm-thick concrete screed topping.

The cofferdam

Cofferdam construction followed marine piling, which has involved installing about 270 m of sheet piles, each 17 m long, from a pontoon.

Embedded 6 m into the ground, the sheet piles connect back to those of the existing quay wall. Thrust blocks and waling beams on the sheet pile cofferdam were also built to receive bracing.

"When all props have been installed and the tide is high, the crane will crawl off the pontoon onto the quay and the pontoon can then be dismantled"

Kevin Keegan, Midgard

With the cofferdam complete, bearing piles went in next. Depending on whether the piles hit flint bands in the ground, installation can take from five to 45 minutes.

Props supporting the sides of the cofferdam have been installed concurrently as areas of bearing piles were completed.

"When all props have been installed and the tide is high, the crane will crawl off the pontoon onto the quay and the pontoon can then be dismantled," Mr Keegan explains.

When the bracing is complete, dewatering can begin. "After dewatering, it's more like building a conventional concrete structure," he says.

With the cofferdam emptied, substructure construction began in mid-July.

This involves building up the seabed to the correct level using local material around the bearing piles, ready for casting an 800 mm-thick basement B3 raft slab made up of 250 mm-deep waterproof concrete.

Cofferdam props will be removed after the 275 mm-deep B2 and B1 reinforced concrete slabs have been cast along with reinforced concrete basement columns, which vary in size from 225 by 550 mm to 350 by 1,250 mm.

The 350 mm-deep reinforced concrete ground-floor slab can then be built. On upper floors, precast concrete columns and cores support 260 mm-thick post-tensioned concrete slabs, spanning up to 10 m, with drylined partitions.

Slim, post-tensioned slabs keep the height of the building to a minimum, with prefabricated building systems employed for fast construction so that the first residents can occupy apartments in early 2016.

The £200m redevelopment of the marina involves two further phases, which include a 40-storey tower with viewing gallery and 655 further residential units.

Once complete, one of the UK's stand-out seafronts will once again rival the finest on the continent.

Piling pontoonage

Initially, there was a plan to install foundations simply from the existing quay wall, but it was soon apparent that conventional machinery would not reach the full extent of the site, so piling equipment had to work off pontoons.

Careful consideration had to be given to ensuring water levels within the cofferdam remained high enough to support the pontoon when water levels outside it had lowered due to low tide, with grilled openings in the cofferdam.

A decision then had to be made as to whether bearing piles within the cofferdam should be installed before or after dewatering – in the wet, or in the dry – recalls JRL Midgard MD Kevin Keegan.

The ground profile is made up of chalk underlying up to 2.5 m of silt.

"The problem was that cranes weigh 80 tonnes and the ground is not solid," Mr Keegan says.

"Piling within the dry cofferdam would mean we had to use restricted headroom equipment for machinery to fit under the bracing [in the cofferdam]. Using smaller equipment would also have meant that it would take longer to install the piles."

Instead, using floating piling ahead of dewatering was considered much more straightforward.

Aquatic complexities

Planning and programming construction activities according to changing sea level has added an extra layer of complexity to the project and all work has to be approved by government's regulatory body, the Marine Management Organisation.

The design of the substructure has had to take the marine environment into account – the basement will be lined with a concrete wall which contains a waterproofing additive and concrete cover to reinforcement that is embedded deeper than on land-based structures.

Site operations have also had to consider effects on aquatic life as well as on vessels moving in and out of the harbour, including the risk of a colossal sand-dredging vessel colliding with the structure, Mr Keegan says.

There are also other factors affecting when deliveries can take place due to the adjacent one-way access road being used by local buses every seven minutes during peak hours.

Consequently, Midgard has a holding yard about 1 km away, from which deliveries can be summoned at the appropriate time.

"Early on, the big focus was on traffic management plans," Mr Keegan says. "With 13 m-long trailers, we have a problem as they can't go round the tight bends [on the one-way system]."

"We have to make arrangements for them to travel against the flow of traffic so they don't have to go round a bend."

The developer and contractor are also acutely aware that noise levels have to be kept to a minimum so as not to disturb residents and visitors who come to the area expecting a tranquil atmosphere.

Piles are vibrated into the ground, rather than installed using a percussive hammer method and Midgard has specified low-noise equipment. It has also chosen not to work at weekends and during lunchtimes.

"We have permission to pile at the weekend from the council, but don't because we don't want to disturb people," Midgard project manager James English says.

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