

Photos: Grace Construction Products.



Figure 1 above: Marine defence work aims to protect 1500 at-risk properties from similar flooding.



Figure 2 above right: Concrete reinforced with Strux 90/40 is poured into a steel mould.

Synthetic macro fibres storm to the

Blackpool promenade is arguably the UK's most famous section of coastline, the sea wall having stood the test of time for generations. However, it is now undergoing its largest ever transformation, incorporating a concrete reinforcement solution that is beginning to make inroads in the field of sustainable marine defences.

BRUCE PERRY, GRACE CONSTRUCTION PRODUCTS

The complete £62m reconstruction of the seafront was always destined to be an impressive feat of maritime civil engineering. The new sea defences being built along 3.2km of Blackpool's shoreline are rapidly becoming a benchmark for the rest of the world. Grace Construction Products was called upon to supply its innovative Strux 90/40 synthetic macro fibre technology to reinforce much of the concrete that is being installed along the length of Blackpool's promenade. It is the first time in the world that this technology has been employed for major reinforced concrete elements in marine coastal defences.

The project

The project, which began last autumn and will take four years to complete, is designed to prevent shoreline erosion and protect more than 1500 commercial and residential properties from flooding. Blackpool's Central Area Coast Protection Scheme is a major part of Blackpool Council's ambitious regeneration master plan, which stretches from the Sandcastle Waterworld, near Blackpool's South Pier, to

beyond the North Pier.

Grace's synthetic macro fibre reinforcement is being used in two main areas of the Blackpool project. It is being cast in-situ to create a 3.2km-long toe beam, which will hold 10,000 steel sheet piles firmly in place and act as a 'stop' to the sea defence steps, or revetment units, which rise from the toe beam to the promenade. It is also being used in the revetment units, which are being precast off site by SLP Precast Limited, at a purpose-built factory near Blackpool.

The Blackpool project was funded by the Department for Environment, Food and Rural Affairs. The main contractor, Birse Civils Ltd, commissioned Tarmac North West to supply the ready-mixed concrete and consultant designer, Halcrow Group Ltd, approved the choice of Grace's synthetic macro fibre to provide the reinforcement, following some innovative problem-solving by SLP Precast Limited.

Trials

Following research and laboratory-based proving trials, full-scale production trials were initiated. In addition to steel reinforcement being replaced by the Strux 90/40 technology, other constituents were included in the concrete mix. These were:

- Grace's Adva Flow 410, a superplasticising admixture, which is added to reduce both the water demand and hence the water/cement (w/c) ratio of the concrete.
- Polypropylene micro fibres, which are added to control the bleeding of water while the concrete is in the plastic state.
- Concrete 'Fylde Buff' colour, added so that the exposed surfaces of the precast concrete closely match the colour of the Blackpool beach sand.

The addition of these four components, alongside CEM I,

Figure 3 below: Revetment unit is vacuum-lifted out of the mould.

Figure 4 below right: Load testing the revetment units.





front of coastal defence innovation

Figure 5 above left: The 3.2km toe beam under construction.

Figure 6 above: Vacuum machine lowering precast unit in front of toe beam.

ground-granulated blastfurnace slag (ggbs) cement replacement, limestone-based aggregates and water, presented the concrete supplier with a challenge in repeatedly producing and supplying a consistent quality of ready-mixed concrete to SLP Precast from a dry batch concrete plant. Nevertheless, the initial trials paid dividends towards achieving a remarkable level of consistency early in the programme.

Project challenges

The use of synthetic macro fibres presented a fundamental challenge for SLP Precast in the production of the revetment units. With the absence of a steel cage, there were no lifting eyes present to enable the straightforward demoulding and lifting of each 20-tonne revetment unit. Therefore, the concrete revetment units were lifted out of the mould by suction. A Dutch firm was commissioned to build bespoke vacuum lifting machines, capable of lifting the units from the mould, turning them 180° for storage while curing and then re-lifting and lowering them onto lorries for transportation to the construction site. A vacuum seal could still be achieved when the concrete surface had been shot-blasted to provide a non-slip surface.

These machines, which have a 20-minute failsafe lock in the event of a vacuum failure, are also being used on site to lift the steps and lower them into position. The revetment units sit four or five deep behind the toe beam, acting as both a seating area for holiday makers and a barrier to the sea – where each step gradually dissipates the force of the incoming waves. Each unit contains 8m³ of fibre-reinforced concrete. In total, approximately 2900 step units will be cast, equating to about 23,000m³ of concrete. SLP Precast produces five revetment units per day.

With regard to the in-situ concrete pours, the fibre-rein-

forced concrete is poured into steel formwork on site to create the 3.2km toe beam. One of the main concerns for Birse was to ensure maximum efficiency was achieved in view of the restrictive tidal windows. The omission of steel reinforcement cages has proved to be a significant benefit. Working times vary considerably according to the height of tides and level of the beach, giving an average working window of only eight hours per day. Birse has been pouring about 15 linear metres per day of the toe beam, compared with about 10m per day on previous jobs where steel has been used.

Using Strux 90/40 also removes the logistical problems of transporting and storing tonnes of steel fabric on site. Pouring the concrete into precast moulds off site, without the problems surrounding the placement of steel cages, has also speeded up that side of the operation.

Concluding remarks

The design life of the new defences at Blackpool is 100 years and because Strux 90/40 has none of the potentially corrosive qualities of steel, which could have been a problem in the aggressive marine environment, Blackpool Council will be able to deliver a project to meet this requirement.

Figure 7 below left: Some of the first revetment units in place.

Figure 8 below: Artist's impression of new sea defences at Blackpool.

Blackpool's Central Area Coast Protection Scheme

Client:	Blackpool Council
Main contractor:	Birse Civils Ltd
Consulting engineer:	Halcrow Group Ltd
Ready-mixed concrete supplier:	Tarmac North West
Precast concrete supplier:	SLP Precast Ltd
Concrete colour supplier:	Roy Hatfield Limited



Beauty and the beast

The versatility of concrete is often overlooked as a construction material. This is most probably linked to its grey 1960s block image. Great strides have been made in residential construction and concrete is invariably used by cutting-edge architects to showcase their innovative approach to the use of traditional materials. Commercial property development is also making use of large amounts of concrete that is not only structural but integral to design.

KEVIN SUTHERLAND, TARMAC

Advances in concrete production and development are giving rise to new opportunities in civil engineering and new kinds of concrete structures – that not only provide excellent performance but are also pleasing to the eye and fit seamlessly within the natural landscape.

The benefits of using precast concrete in construction are well accepted: strength and durability; low whole-life costs; fast and efficient builds; low maintenance and good environmental credentials. Concrete is not only incredibly strong and hard-wearing but also different surface treat-

Not only are these North Fylde Coast sea defence contracts architecturally and aesthetically demanding but also the variety of concretes required to fulfil client specifications has created unusual operational and manual handling challenges.

ments can give rise to a range of different textures and finishes, while different conditioning admixtures can produce an array of different colours. However, the use of coloured and finished concrete in contracts of this type presents the industry with a new set of challenges that require a wholly customer-focused approach to business.

The project

For over 100 years the old sea wall has provided Blackpool with protection from coastal erosion and flood alleviation. But constant bombardment from the sea has taken its toll and much of the defensive structure now needs to be replaced. The new sea wall and defence scheme has been designed to continue to protect the town while at the same time improving public access to the sea and providing a clean and modern look for Blackpool's seafront.

Tarmac's contract is to supply two schemes: the Blackpool Council Central Area Coast Protection Scheme and Wyre Borough Council Cleveleys Coastal Defence Scheme. Tarmac is supplying main contractor, Birse Civils Engineering Limited, with all its in-situ concrete requirements and SLP Engineering with concrete for the precast

Figure 1: Tarmac delivers to the seafront in Blackpool.

(Photos: Birse Civils Ltd and Blackpool Council.)



Figures 2 and 3: The completed seafront scheme.

