ORLITECH®
Composite systems

CASE STUDY

PROJECT

MIAMI DOCK

> “We have completely replaced the steel reinforcement, the issue of corrosion has totally disappeared.”
>
> Dr Antonio Nanni

OVERVIEW

Replacement of hurricane Irma damaged concrete pile and a wooden dock with BFRP and GFRP precast concrete components elements and gratings. One of the goals of the project was to eliminate corrosion of the reinforcing steel, so in this case Fibre Reinforced Polymers (FRP) composites were used. The project showcased a number of FRP products among them basalt FRP from Galen (manufacturing partner to Orlimex UK). The presence of noncorrosive reinforcement allowed the use of seawater instead of freshwater in the production of the concrete mix.

By 2050 we will have approximately 10 billion people on the planet which is going to put a huge strain on natural resources such as drinking water, it is estimated that concrete production will use in excess of 2000 billion litres of freshwater annually in the cleaning of the aggregate and for the concrete mix itself. Having the ability to produce concrete which can be manufactured using saltwater will remove the stress on fresh water supplies Globally. With this in mind the University of Miami researched the possibility of manufacturing concrete using non-potable water. The project lead, Dr Antonio Nanni identified the problem of chloride attack of ferrous reinforcement and referred to his past research of FRP he proposed the use of basalt FRP bars from Galen.

The dock is built with a form of sea-water based concrete that University of Miami researchers have developed in collaboration with the Polytechnic University of Milan, the Florida Department of Transportation and industry partners. The University of Miami calls its product Seacrete.

DURABLE • RESISTANT TO CORROSION, ALKALINE & ACID SUBSTANCES

The use of seawater in the concrete mix allows the production of a more sustainable concrete structure by eliminating the use of freshwater, a scarce resource. The concrete dock was constructed using precast elements of piles, pile caps and slabs. The piles and pile caps were reinforced with FRP rebar in place of steel rebar and the slabs were reinforced with basalt fibre reinforced polymer bars and mesh. This structure was designed to withstand wind and wave loads of a category five hurricane.

This type of concrete production can only be brought to the market if the reinforcement is non-metallic. Basalt FRP reinforcement is unaffected by chlorides and is highly resistant to acids and alkalis meaning that there is no problem using seawater in the concrete mix.

In addition, recycled aggregates can be added to the new concrete mix, previously this had not been an option due to the fact that there could have been chlorides present within the old concrete which would have attacked the structural steel. In addition, research suggests that the use of recycled concrete increases the porosity of the concrete thus facilitating the passage of moisture within the new concrete increasing the risk of corrosion if steel reinforcement is used. Using basalt FRP reinforcement in place of steel is now a viable option.

Concrete production is a huge industry and more than 4 billion cubic metres of concrete is produced every year. Seawater concrete could help limit water usage freshwater usage and increase the longevity of concrete structures. Currently construction codes prohibit see water-based concrete but the viability of fibre reinforced polymer as a replacement for steel will open up the industry to a more sustainable and cost-effective alternative.

The use of seawater within the production of concrete would enable concrete production on site eliminating the requirement to transport freshwater. Sea water-based concrete will be especially useful for island nations with limited access to freshwater.

Seawater concrete is not a new phenomenon, the Romans used a version of it for their coastal constructions many of which still stand today. The concrete structure was actually strengthened over time due to chemical reaction between the seawater and the hydrated lime used in Roman concrete.

Bridges are built with a projected '50 year' lifespan, but the new design is expected to greatly increase their life by at least 50 years. A recent study found that corrosion is responsible for three quarters of maintenance costs on bridges; using FRP in place if steel would greatly reduce these maintenance costs.

> "This project is iconic in the sense that it allows the public to understand what we can do in the construction industry to really become more responsible to the needs of society."
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> Dr Antonio Nanni

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