MACCAFERRI
SOUTHERN AFRICA

EDITORIAL
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MACFORCE - A NEW WAVE IN RETAINING SYSTEMS
DIEP RIVIER, W CAPE

GEOTECHNICAL ENGINEERING
Reinforced Soil Walls

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Maccaferri's acquisition of UK based concern, Linear Composites, has added a new product line to the Italian conglomerates stable in the environmental engineering field.

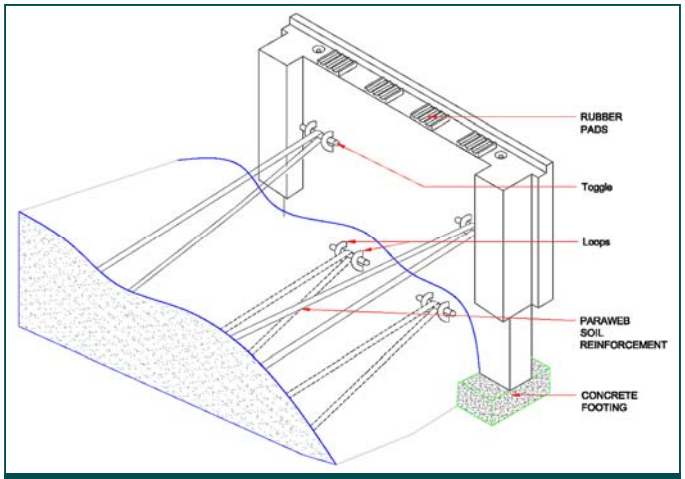
In the Western Cape, Maccaferri Southern Africa's MacForce precast concrete panel retaining system has undergone its first application in the local market as a river bridge nears completion near Malmesbury. The bridge, designed by consultants, Ninham Shand, crosses the Diep River - a wide, marshy floodplain area - has been constructed by Civils 2000.

The project commenced in 2006, with the first MacForce panels installed in January 2007 to form the retaining system on the bridge's false abutments, with the last units going in during June. The bridge's deck is constructed from precast beams and is supported on prestressed piers on a piled foundation, whilst the transition slabs on either approach are supported by these false abutments, which in turn protect the embankments from scour.

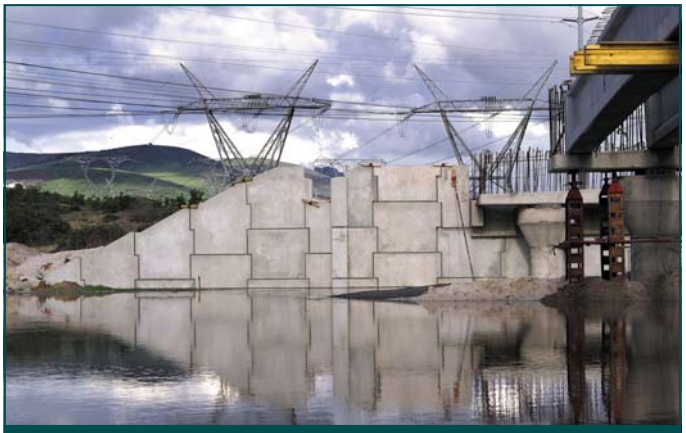
This is a slow moving river, so the rise and fall of water entering the abutments through the permeable MacForce system will be gradual. For the Cape project, the panels were cast on site using special moulds supplied by Maccaferri, with the final MacForce wall installations on either side of the river covering a total area of approximately 411m². The concrete mix design in this instance used Cape Flats Sands, which is a single size material with a low friction angle.

"For the Cape project, the MacForce system is ideal given the wet conditions and fluctuating water table - depending on the season - as it has the capacity to settle. In other words, it's a flexible rather than a rigid system," says Joseph Meadows regional manager for Maccaferri's Johannesburg office. "If a rigid system had been installed, this would have to make provision for settlement, and that can be a costly exercise. For example, some of the piles on this project reach bedrock and others operate on friction. The benefit of the MacForce system is that it accommodates differential settlement without putting the integrity of the structure at risk."

As Meadows explains, these steel reinforced 25 MPa concrete MacForce panels are specially designed for the construction of reinforced soil walls, bridge abutments and mine tips. The system offers significant costs benefits, relative simplicity of installation (since unskilled labour can be used), plus speed of construction (for mines this means ramping up production earlier). The ability to cast the panels on one site also makes the MacForce system particularly attractive when working in more remote regions.



Rear isometric elevation of panels


A calm flow past the Diep Rivier bridge, MacForce abutment


Special Panel ready for placement

Of course, as for all mechanically stabilised structures, the complexity is in the design, and the "secret" is in the connection, since this is a friction anchoring system, says Meadows, expanding on the benefits of this new, but traditionally non-core technology within the Maccaferri stable.

Diep Rivier bridge with crane installing MacForce panel

Gabions and concrete

In the past 125 years of Maccaferri's history, this Italian owned global concern has focused predominantely on designing and developing environmentally engineered solutions using wire mesh gabion retaining wall systems. Examples of these modern day applications include the patented Terramesh (stone filled face) and Green Terramesh (vegetated front face) solutions. These Terramesh systems are made of a series of pre-assembled units, which can be easily joined to form a flexible, monolithic soil reinforcement structure. Each unit comprise a front face and reinforcement tail made from one continuous, heavily galvanised or Galfan coated and PVC coated double twist wire mesh panel.

"This traditional strength in using wire meshed products is now being extended with the introduction of concrete products, like MacForce, to meet differing client demands," explains Meadows. "This follows a strategic decision by Maccaferri in 2006 to acquire UK based concern, Linear Composites, which manufactures specially formulated synthetic polymeric materials, examples of which include ParaLink (used for reinforcement over piled foundations) and ParaWeb (which has been used on southern African projects in the past). The latter is produced in strips to form tie-backs for the MacForce panels. In fact, Linear Composites has used the identical ParaWeb/ precast panel system for more than 20 years in the UK and for the past four years in India."

Checking clearance between MacForce panel and bridge

ParaWeb is a radical, and cheaper alternative to steel tie-backs (where rust and corrosion would be a factor) especially in aggressive soil or marine conditions, for example in rivers with fluctuating water tables, such as on the Cape bridge project. The product comes in different grades varying from 50 to a 100 kN – depending on the structure and the loading expected. Other Linear Composites products include basal reinforcement, a topic which will be covered in Maccaferri SA's lecture series in September 2007.

T-shaped

MacForce's T-shaped concrete panels (with an average area of 3,2m^2 and a weight of just over 1 000kg), can either be 140mm (standard), 160 or 180mm thick. There are also rectangular sections for bottom sections and special cruciform shaped panels to accommodate specific profiles, such as wing walls.

"A 160mm thick panel (specified for the Cape project) allows for an exposed aggregate finish, if required; whilst a 180mm thickness would be specified where a more robust panel is needed," Meadows continues. "The panels have a positive connection with six loops (points of attachment) that are embedded into the precast to which the ParaWeb strips are connected."

Careful adjustment for placing panel under bridge soggit

The important factor to emphasise is that MacForce and ParaWeb operate as a friction system. Installed from one continuous roll, ParaWeb is connected to the panel's anchoring points at specified intervals in a zig-zag type pattern, which extend backwards, in the case of the Cape project by approximately 5,6m to anchoring points. Once connected and positioned, the ParaWeb framework is tensioned with steel poles and the area behind the panel backfilled with saturated soil to achieve the necessary compaction. After doing this, the poles can be removed, since as explained previously, this is essentially a friction and not an anchoring system. Thereafter, the process is continued in successive layers.

Behind these panels, each joint is covered with geotextile to ensure free movement of water, but without allowing the migration of soil through cracks, which would form a cavity.

"Although a relatively small-scale installation, the Cape bridge project is significant for Maccaferri as it is the first local MacForce application. It is also significant because in the field of retaining walls, bridge abutments – whether false or true – are considered to be challenging from a design perspective," Meadow continues. "This is especially the case in water scenarios, where you have greater risk of eruptions or wash-aways." For longer-term evaluation, ParaWeb sample strips have been left on both abutments for 5, 10, 20 and 50 year periods. A panel movement programme is also in place to record the hydraulic effects on the MacForce panels.

"MacForce is the front runner for a host of new product innovations in precast retaining wall panelling systems. Added to this development, Maccaferri will soon be rolling out the MacRes (Maccaferri Reinforced Earth Solution) panel, which lends itself far more to architectural finishes and is even simpler to install," says Meadows.

"The vertical panel configuration of these walls means that slight misalignment due to settlement has minimal impact on architectural motifs," Meadows explains. "And like the MacForce system (which will be targeted more at marine and mining applications), installation can be effected with a light crane. MacRes also has only one corner to meet all panel fitment angles, making the system incredibly versatile."

Maccaferri recently completed a launch project in Italy using the MacRes system on a bridge abutment, which has proved to be very successful, with further projects now ongoing.

Adds Meadows: "For the mega projects like Gautrain, and developments ahead of and beyond 2010, we believe that, like MacForce, the MacRes system will prove equally successful in South Africa."

Compiled by Alastair Currie, Editor, Construction World

Diep Rivier bridge

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