

Geotechnical Services

Ground Anchoring, Soil Nailing, Micropiling, Dam Anchoring,
Permeation Grouting, and Slope Stabilisation

Australia's Leading Specialist Construction Company

Fortec is an Australian, employee-owned company delivering fit-for-purpose, innovative, and cost-effective construction, engineering, and geotechnical solutions.

We take pride not only in the quality of our work but also in the long-lasting relationships we build with our clients.

Founded in Perth in 2015, our mission has always been to connect clients with experienced industry professionals. This client-focused approach has driven our growth and expanded our services nationally.

With extensive experience across Australia, we serve the **infrastructure, building, and resources sectors**, providing solutions that are practical, innovative, and tailored to each project.

Fortec delivers specialist construction, engineering, and geotechnical services to public and private sector clients, including water and road authorities and developers of infrastructure, commercial, industrial, and residential projects.

Our team has a wealth of experience in the specialist design and construction of

Built on great relationships

infrastructure and solving complex construction and engineering challenges. One of our primary aims is to provide technical advice and designs which benefit the client both practically and economically.

Early engagement on projects enables our clients to harness engineering and construction know-how and innovative ideas, to ensure better project outcomes.

With the support of our strategic partners, Fortec is able to offer a range of alternative construction techniques aimed at optimising solutions for our clients' requirements within budget, while considering the risks, project constraints and delivery environment.



Implementing best practices in HSQE

Sustainability

We adopt strategies and practices that aim to meet the needs of today's society without compromising the human and natural resources that will be needed in the future. Working with and building positive relationships with all stakeholders enables us to bring to the forefront ideas and innovations that enhance the responsible management of resource use in the environment in which we work.

Our group initiatives in HSE management, youth training, indigenous engagement and support of local communities have been frequently acknowledged by industry and government bodies.

Our Sustainability Framework

We implement best-practice Health, Safety, Quality and Environmental Management systems that support our business in delivering projects safely, to a high standard and without harm to the environment.

We aim for continual improvement in all that we do and adopt strategies and practices that aim to meet the needs of today without compromising the resources that will be needed in the future.



Our Services

Geotechnical Specialists

Geotechnical



Complete Project Solutions



The Geotechnical Unit is a trusted contractor serving clients in the oil and gas, mining, government, utilities, and infrastructure sectors. It provides a comprehensive range of geotechnical and engineering solutions including ground anchoring, soil nails, micropiling, dam anchoring, permeation grouting, and slope stabilisation across Australia.

With many years of experience and expertise, the unit boasts an extensive fleet of owned plant and equipment, supported by a fully flexible and mobile workforce. Complete project solutions are delivered with excellent value for money, backed by strong project management and technical capabilities that ensure timely delivery within the required design parameters.

The unit has earned a reputation for successfully undertaking challenging and complex projects while maintaining the highest standards of quality, environmental stewardship, and safety control.

Our Services

Geotechnical Specialists

Geotechnical



Anchoring: Permanent & Temporary

Ground anchors provide stability and support to structures and have a wide range of uses. Fortec Geotechnical can provide a design and installation service including stressing/load testing for the following applications:

- Temporary and permanent active anchor systems for a wide range of structures including dams, bridges and wind towers
- Temporary sheet pile and retention systems
- Dead man anchor systems
- Jetty and dolphin tension ground anchors



Slope Stabilisation

Slope stabilisation is used to secure embankments or to rectify walls and slopes that have succumbed to natural forces which require stabilisation to ensure the safety of the structure and the surrounding environment.

We provide a diverse range of solutions for a variety of applications including:

- Rock fall barriers and debris flow barriers
- Soil nailing - temporary or permanent passive soil nails
- Rock Bolting and FRP systems
- Shotcrete and retaining walls
- Erosion control





Permeation and Pressure Grouting

This technique is generally used to reduce permeability and/or strengthen and stiffen the existing ground. The process typically consists of grout filling the accessible pores between the solid particles in the existing permeable soil.

Common applications include:

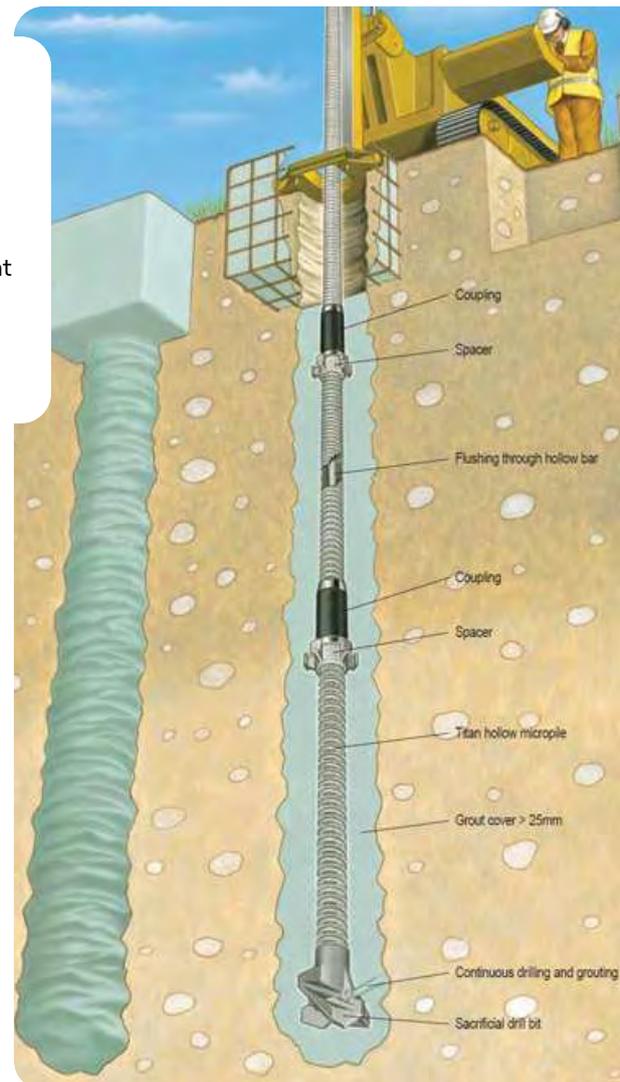
- Ultra-fine cement grouting
- Void filling (under slab filling or naturally occurring voids)
- Underpinning and subsidence stabilisation
- Pressure grouting and grout curtains



Micropiling

A micropile is a small diameter, drilled and grouted non displacement pile that is typically reinforced. The micropile is installed by drilling a borehole, placing reinforcement and grouting the hole. Micropiles can be installed using relatively small drill rigs and equipment. Common applications include:

- Conventional bored or CFA pile redesign and alternate micropile replacement
- Micropiles can act in tension or compression
- Micropiles can retro fit into existing structures, difficult access or low head room where conventional bored and CFA method are not practical or economical



Multistrand Anchoring

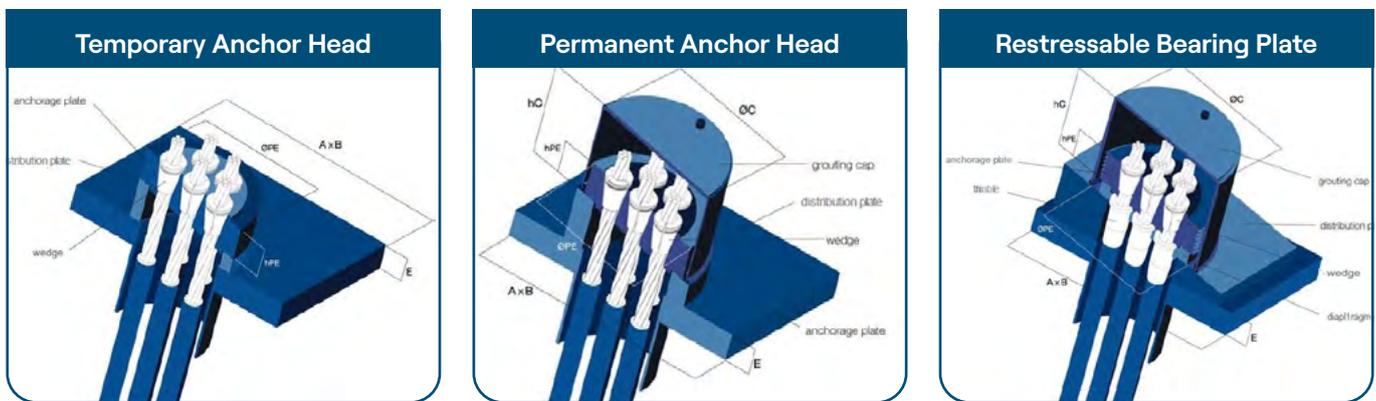
Geotechnical



Permanent and Temporary

Multistrand anchoring utilises specialist materials, technology and stressing equipment to apply a uniform force to each strand within a multistrand anchor assembly. The post tensioning of the multistrand system is undertaken after the grouted body has cured and reached a specified compressive strength. The individual strands are simultaneously jacked and locked off at the live end by wedges.

Fortec Geotechnical provides both temporary and permanent multistrand ground anchors. Depending on the design life and application, multistrand anchors can be certified for a design life up to 100 years. Long term service durations are achieved by implementing HDPE corrugated plastic sheathings, hot dipped galvanised elements, anti-corrosion greases/agents, etc. Anchor capacities can range from 250kN – 25,000kN and beyond.

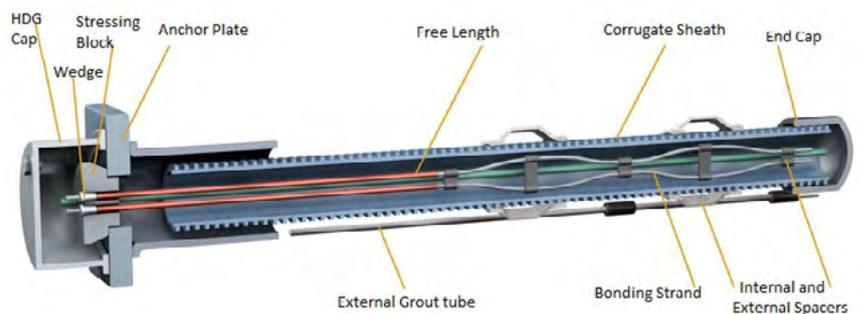


The typical system of a permanent multistrand anchor comprises of a high tensile steel element encapsulated within a HDPE corrugated sheath (physical barrier for corrosion protection). There is a bonded length and a free length. The bond length is the section of the system that is anchored into the competent ground and transfers the load into the surrounding rock/soil. The free length is constructed with the addition of a smooth wall sheathing filled with anti-corrosion grease and placed over the steel element to provide additional protection and allows elastic elongation when tensioned. The inner and outer annulus of the HDPE corrugated sheathing is simultaneously grouted to transfer load and to provide long term durability.

To completely seal and protect the anchor heads/wedges from corrosion, hot dipped galvanised caps filled with anti corrosion void fillers are installed after the anchors are stressed.

Fortec Geotechnical provides re-stressable and monitorable anchors and offers specialised anchor heads that permit the connection of load cells and monitoring equipment. The system allows the anchor to be test loaded to determine the residual load in the anchors and allow re-stressing if required.

The application of the re-stressable and monitorable anchors are most commonly used in dam, bridge tunnelling construction.





Fully Encapsulated Permanent Ground Anchors (15.2mm Strand)				
No. of 15.2mm Strands	Ultimate Breaking Load (kN)	Bore Hole Diameter (mm)	Min. Corrugated Tube Diameter (mm)	
			ID	OD
2	522	102	50	65
4	1044	127	65	85
7	1827	152	80	96
12	3132	178	100	128
19	4959	216	125	158
22	5742	216	125	158
27	7047	216	125	158
31	8091	216	125	158
42	10962	311	210	230
55	14355	311	210	230
65	16965	311	210	230
91	23751	350	250	280

Note: Anchors larger than 100 x 15.2 strands are available subject to design certification. Minimum external cover is 10mm. Smooth high-density polyurethane sheath is available for the free length of tendon and load cells can be supplied for electrical and hydraulic systems. Safe working load as per AS4678.

Temporary Ground Anchors (15.2mm Strand)		
No. of 15.2mm Strands	Ultimate Breaking Load (kN)	Bore Hole Diameter (mm)
2	522	76
4	1044	89
7	1827	102
12	3132	114
19	4959	165
27	7047	178
31	8091	178
42	10962	229



The sinusoidal duct is used to provide corrosion protection in permanent anchors, and can also allow the electrical isolation of rock anchors and multistrand systems should that be required.

Typical Anchor Data

Geotechnical



Anchor Head - Summary of Components, Equipment and Dimensions											
Anchorage		Anchor Plate		Distribution Plate				Grout Cap		Stressing Equipment	
Tendon	Series	ØPE	Hpe	A	B	E	ØTE	ØC	hC	Jack	Hydraulic Pump
2/0.6"	D		55					-	-		
	DP		61					127	125		
	DR		55					-	-		
3/0.6"	D	110	55	250/300	250	30	108	127	125	MS1	
	DP		61								
	DR		55								
D	61										
DP	55										
DR	61										
4/0.6"	D		55					-	-		
	DP		61					127	125		
	DR		55					-	-		
5/0.6"	D	140						-	-		
	DP	150						152	125		
	DR	140						168,3	147		
6/0.6"	D	140		300/320	300	35	127	152	125	MS2	
	DP	150	55								
	DR	140									
D	150										
DP	140										
DR	150										
7/0.6"	D							-	-		
	DP							152	125		
	DR							168,3	147		
8/0.6"	D	158		330/340	330	45	132	168	151		BPT11
	DP	180									
	DR	158	65								
D	180										
DP	158										
DR	180										
9/0.6"	D							-	-		
	DP							219	160		
	DR							168	151		
10/0.6"	D	172		375/410	375	55	155	188	171	MS3	
	DP	190									
	DR	172									
D	190	77									
DP	172										
DR	190										
11/0.6"	D							-	-		
	DP							219	171		
	DR							188	171		
12/0.6"	D							219	171		
	DP							-	-		
	DR							188	171		
19/0.6"	D	200		400/400	400	70		220	200	MS4	
	DP	220	94								
	DR	200									
D	240										
DP	200										
DR	240										
31/0.6"	D	268						-	-		
	DP	296	110					278	250	MS7	
	DR							316	250		

Note: the distribution plate can be supplied with inclination angles that range from 00° to 300°. ØTE is for the centre hole of the distribution plate

Ground Support and Slope Stabilization



Permeation and Pressure Grouting

Soil nails and bar anchors offer support to slopes or batters for stability/remedial applications such as unstable batters/slips or for excavations where batter steepening is needed. The system requires drilling a hole into a face at a declining angle from horizontal to a predetermined depth followed by the insertion of a bar placed centrally into the hole and encapsulated with cement grout.

Soil nails and bar anchors are installed in a uniform grid pattern across the batter and support/reinforce the face. The load is transferred by a cogged bar or nut and plate and typically combined into the designed surface structure (shotcrete) or ground stabilization technologies (rockfall netting or geo grids).

Soil nails are typically a “passive system” and bar anchors are typically an “active system”. Loads can range from 150kN – 3,690kN and beyond (dependent on bar). The passive system is when an installed element is not stressed. The active system is when an installed element is stressed/loaded and locked off.

Depending on the design application and service life, soil nails and bar anchors can be temporary or permanent and can be certified for a design life up to 100 years. Long term service durations are achieved by implementing HDPE corrugated plastic sheathings, hot dipped galvanised elements, anti-corrosion greases/agents, etc.



Typical Soil Nail Properties								
Steel Grade 500	Nominal Diameter mm	Cross Sectional Area (mm ²)	Min. Yield Strength (MPa)	Min. Tensile Strength (MPa)	Yield Load (kN)	Ultimate Load (kN)	Elongation A >(%)	Liner Weight (kg/m)
Threads are left hand Available in HDG and epoxy coated	20	314	500	600	157	188	6	2.47
	25	491	500	550	245	270	6	3.85
	28	616	500	550	308	339	6	4.83
	32	804	500	550	402	442	6	6.31
	40	1257	500	550	628	691	6	9.86
	50	1964	500	550	982	1080	6	15.41
	63.5	3167	555	550	1758	2217	6	24.86
Steel Grade 930	Nominal Diameter mm	Cross Sectional Area (mm ²)	Min. Yield Strength (MPa)	Min. Tensile Strength (MPa)	Yield Load (kN)	Ultimate Load (kN)	Elongation A >(%)	Liner Weight (kg/m)
Threads are right hand Available in HDG and epoxy coated	25	491	930	1080	457	530	6	4.1
	32	804	930	1080	748	868	6	6.65
	36	1018	930	1080	947	1099	6	8.41
	40	1257	930	1080	1169	1358	6	10.34
	50	1954	930	1080	1827	2121	6	16.28



Permeation and Pressure Grouting

Rock bolts are used for slope stabilisation, in batters and tunneling where a steel or GFRP rod is inserted into a drilled hole in the surface or walls of a rock formation to provide support. Rock bolt reinforcement can be used in any excavation, is simple and quick to apply, and is relatively inexpensive. The installation can be fully mechanised. The length of the bolts and their spacing can be varied, depending on the reinforcement requirements.

Generally, there are three major ways of anchoring the rock bolts: mechanical, grouted, and friction. The most common form of mechanically anchored rock bolt uses an expansion shell. A wedge attached to the bolt shank is pulled into a conical expansion shell as the bolt is rotated. This forces the shell to expand against the wall of the borehole. The two mechanisms by which the shell is anchored against the borehole wall are friction and interlock. A preload can be applied to the rock surface by tensioning the bolt with an attached hanger or face plate, which are designed to distribute the load uniformly onto the surrounding rock.

The most common grout-anchored rock bolt is the fully grouted rebar, a threaded bar made of steel. Cement or resin is used as the grouting agent. A cable bolt is a reinforcing element made of steel wires in the form of a strand or rope; it is installed in the borehole with cement grout. Self drilling and hollow bar anchors/bolts are common with the relatively easy handling and installation methods due to fully mechanized systems.

Friction-anchored rock bolts represent the most recent development in rock reinforcement techniques. Frictional resistance to sliding is generated by a radial force against the borehole wall over the whole length of the bolt.



Expansion Shell Rock Bolts

Borehole Ø mm	Type	For Bar Sizes												Rock Quality	Length of Core			
		15F	16T	16W	18TR	20T	20W	22TR	25T	25TR	26WR	28T	28TR			30TR	32T	
33/37	2,128	.	.		.												Hard	35
34/38	2,184	.		.	.												Medium	50
34/38	2,185			.													Medium Hard	65
34/38	2,135	.	.		.												Hard	35
39/46	2,117	.	.		.	.											Hard	50
44/47	2,185				.		.	.									Medium	85
43/48	2,136	.	.		.	.		.									Hard	47
50/58	2,137	.	.		.	.		.	.	.	.	.	.	.	.		Hard	50
59/60	2,221							.	.	.	.	.	.	.	.		Hard	65



Fibre Reinforced Plastic (FRP)

Fibreglass reinforced plastic is a continuously threaded solid bar which forms a high load carrying bar anchor or soil nail. The use of FRP soil nails or bar anchors are selected for specific requirements but typically used for temporary works for the ease of removal/future excavation through the element.

- FRP systems advantages:
- FRP is non-ferric (non-metallic) and possesses non-corrosion properties (rust and acid resistant)
- FRP eliminates electrical currents/conductivity
- FRP is light weight, easily handled and high tensile strength
- FRP is easily demolished when service is not required



Hollow Bar Properties														
Anchor/ Pile Type	Unit	30/16	30/11	40/20	40/16	52/26	73/56	73/53	73/45	73/35	103/78	103/51	103/43	127/103
Nominal Outside Diameter Ø	mm	30	30	40	40	52	73	73	73	73	103	103	103	127
Nominal Inside Diameter Ø	mm	16	11	20	16	26	56	53	45	35	78	51	43	103
Effective Cross Section A eff	mm ²	336	415	730	900	1,250	1,460	1,615	2,239	2,714	3,140	5,680	6,025	3,744
Ultimate Load F _u	kN	245	320	540	660	925	1,035	1,160	1,575	1,865	2,270	3,660	4,155	2,320 ²⁾
Yield Point F _{0,2,k}	kN	190	260	430	530	730	865	975	1,220	1,390	1,800	2,540	3,132	2,015
Yield Stress f _{0,2,k}	N/mm ²	565	627	589	589	584	592	604	545	512	573	447	520	538
Axial Rigidity E x A l)	10 ³ kN	63	83	135	167	231	272	299	414	502	580	1,022	1,083	691
Flexural Rigidity E x I l)	10 ⁶ kMmm ²	3.7	4.6	15	17	42	138	143	178	195	564	794	838	1,114
Weight Approx.	kg/m	2.7	3.3	6.1	7.2	10.7	11.2	13.9	17.8	21.2	25.3	44.3	47.2	28.4
Standard Length	m	3	2/3/4	3/4	2/3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3	3
Thread Left/ Right Hand	-	Left	Left	Left	Left	Left	Right	Right	Right	Right	Right	Right	Right	Right

Permeation and Pressure Grouting

Geotechnical



Permeation grouting can be used to solidify and to create a 'stable mass' from the existing unstable sands and other non-cohesive soils at depth.

Permeation grouting is generally carried out in defined zones utilising injecting lances inserted into the ground at desired distances. This method allows the grout to be injected at a specified location with typical depths ranging up to a few metres.

Specialist drilling rigs and equipment is often used for larger depths or as required for the specific project and ground conditions.

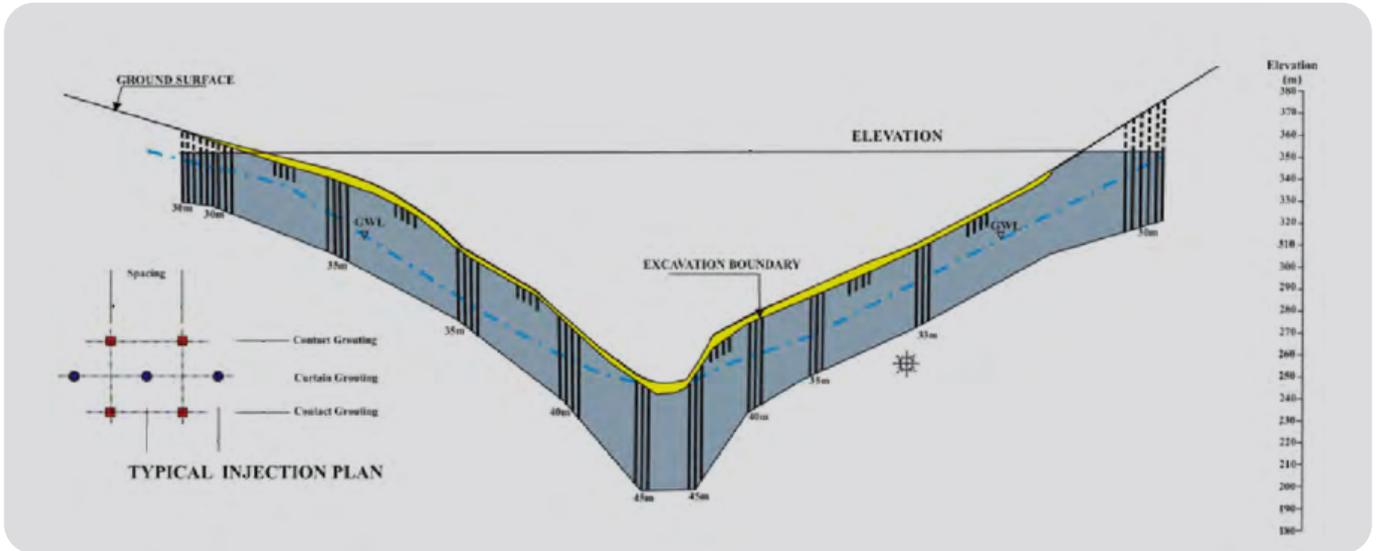
General purpose, microfine or ultrafine cement, sodium silicate or other chemicals (epoxy or polymer) is injected at low to medium pressures into the treatment zones at pre-determined depths and pressures. Volumes and flows are monitored to ensure that the 'flowable injected material' is acting at the required location.

The injected liquid permeates/flows through the soil/stratum to bond the particles together.

It is vital to carefully set out the injection pattern to achieve full cohesion in the desired location and for its intended purpose.

Typical applications of permeation grouting are:

- Existing footing/structure improvement due to settlement. Increasing the bearing capacity and/or structural nature of in-service elements.
- Void filling under subsided existing reinforced slabs and footings. Arresting any further subsidence of the structure by filling the 'space' with grout. Slabs and joints can be further pressure injected to correct and/or level sunken areas to reinstate/remediate the surface to the previous design surface level
- Ground consolidation – pre or post excavation. Prior to excavation, the known boundaries of an excavation or slope can be grouted hence providing a safe and solid face for excavation. Consolidation can reduce or eliminate the need for additional temporary shoring
- Grout curtains/cut off walls – a grout curtain is a barrier that protects the foundation of a dam from seepage and can be made during initial construction or during repair. Additionally, they can be used to contain subterranean flows



Dam Infrastructure

Monitoring and Lift Off Testing

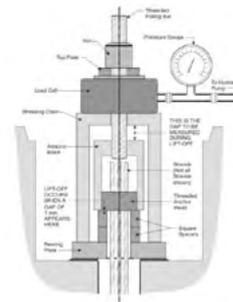
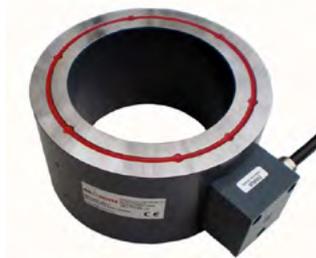
Geotechnical



Long term testing, maintenance and monitoring of anchored structures are another area of expertise for Fortec Geotechnical. Dependant on the project requirement and specifications, short and long term lift off testing and monitoring can be undertaken.

The use of our engineered de-stressable and re-stressable systems allow safe testing of the in service structure. Each anchor head consists of a wedge plate with an external thread and a load bearing sleeve with an internal thread to allow adjustments of the system. Therefore, the anchor head is positioned at the required height at the same time as maintain the multistrand anchor load. Our systems provide the ability for multiple de-stressing and de-stressing cycles.

Replacement and maintenance of the corrosion protection elements are undertaken during the load mentoring stage. Fortec Geotechnical is experienced in the implementation, integration and use of load cells and remote monitoring systems.





Contact us

info@fortec.com.au
www.fortec.com.au



14 Boulder Road
Malaga **WA** 6090
08 6102 6870

Unit 6
15 Motorway Circuit
Ormeau **QLD** 4208
07 3106 4220

Unit 12
55-57 Newton Road
Wetherill Park **NSW** 2164
02 8203 6127

