Retaining Walls
Soil Nailing
Reinforced Soil

www.phigroup.co.uk
Welcome to Retaining Walls, Soil Nailing and Reinforced Soil specialist Phi Group.
Phi Group is the largest retaining solution specialist in the UK, designing supplying and building retaining structures including timber crib and concrete crib retaining walls, soil nailing, soil panels, modular block reinforced soil systems, concrete panel faced reinforced soil and planted/grassed reinforced soil slopes.

A complete service is offered including design, supply and construction undertaken by the company’s in house chartered engineers and backed up by full indemnity insurance.

Based in Cheltenham with regional offices in Wetherby and Dunfermline the company is at the forefront of retaining structure technology balancing engineering demands with environmental consideration.

Phi Group’s own directly employed experienced construction teams, operate nationwide completing the total design, supply and build package, thus affording, optimum peace of mind and minimum risk, to client and contractor alike.

For an audience of 10 or more people the company offers a complimentary lunchtime CPD presentation at your offices. The seminar identifies the primary reasons for using retaining structures and how cost and programme savings can be made by utilising the latest retaining wall and soil stabilisation techniques.

Phi Group’s procedures follow an Integrated Management System which has resulted in ISO 9001, ISO 14001 and ISO 18001 accreditation. Full Link Up accreditation enables Phi Group to provide engineering solutions to the railway sector and many products have BBA technical approval.

If you have a project requiring a retaining structure, Phi Group will be happy to supply you with a free quotation, please send us your existing and proposed levels survey together with any available site investigation information.
Gravity Retaining Walls
Gravity walls use their self weight to counteract the earth pressures and surcharge loadings and can be constructed from various systems

Permacrib
Andacrib
Gabions
Lockstone

4-7

Soil Nailing and Facings
Soil Nailing is a method to stabilise existing embankments using grouted steel bars. A facing can then be applied to create the required aesthetics, be it grass, flexible, or hard facings.

Soil Panel (Stone Filled)
Soil Panel (Grass face)

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Reinforced Soil Solutions
The use of reinforced soils is mainly used in areas of fill to support elevated levels. These walls can be vertical with the block wall systems, or have a stone/soil finished batter between 50 and 70 degrees.

Textomur
Titan
Geolock
Concrete Panel System

12-15
Permacrib is our timber crib retaining wall system using patented interlocking components. These components form a series of open cell modules which are filled with well graded crushed stone to create the required mass. Permacrib’s lightweight components mean that the system is built by hand with no special plant requirements enabling extremely fast production rates.

**Application**
Uses include simple landscaped walls and major civil retaining structures. Additionally, Permacrib can be used to provide a landscaped and aesthetically pleasing face to reinforced earth or soil nailed structures. It can also act as a facing to sheet piling or concrete retaining walls, as well as creating vertical acoustic barriers.

**Composition & Manufacture**
Permacrib is manufactured from selected Radiata Pine softwood from managed, cultivated, renewable plantation resources. This ensures that environmental concerns for the conservation of resources and a sustainable future are met. Manufacturing is carried out to an approved Q.A. system ensuring a high level of dimensional accuracy. All machining is completed before treatment.

**Durability**
All components are pressure treated to BS.8417:2011 using High Concentration Copper Azole preservative to provide a Desired Service Life of 60 years. Complete cell penetration is achieved to give full protection. Permacrib is treated and cured at U.K. plants which are subject to stringent environmental health controls and checks.

**Economical & Flexible Design**
Design versatility of the 8 readily available models enables header sizes to be mixed within the same structure for maximum economy or in major structures double or triple skin walls can be built. Face profiles can be varied to form benches to assist landscaping and enhance architectural appeal. Angle changes are easily formed and radii followed.

**Technical Approval**
The Permacrib system is the only timber crib system that has been awarded a British Board of Agrément Certificate.
Mitigation of Greenhouse Effects
Trees are the lungs of the earth - absorbing CO2 and converting it to oxygen. Mature trees absorb less CO2 therefore by harvesting and re-planting with young specimens a constant cycle of CO2 absorption is ensured. Manufacture and construction are very simple and requires low levels of energy.

Sustainability
Timber for the Permacrib system meets the requirements of the “UK Government Procurement Policy” as being from both a legal and sustainable source.

Landscaping
Permacrib can be fully landscaped with a variety of plants in order to enhance its natural appearance.
Andacrib is a modular pre-cast concrete crib retaining wall system which has been designed to cater for the most onerous loading conditions demanded of structures in highway, industrial and commercial sectors.

Andacrib’s unique design, incorporating generous header to header bearing surfaces, ensures that all primary loads are remote from the exposed face. The design also allows for the various header lengths to be mixed within the same structure for maximum economy whilst maintaining a consistent visual appearance. Andacrib header units can be linked into double or triple skin walls, whilst internal and external curves can be formed.

**Applications**

Andacrib’s flexibility enables it to be utilised in a variety of situations:
- Road and Railway embankments and cuttings
- Bridge and underpass wing walls and approach ramps.
- Sewerage / Water Treatment Plant Developments.
- Local authority developments, schools, public service buildings etc.
- Airport development and improvements.
- Retail Parks.
- Service Stations.
- Car Parks.
- Leisure Developments.

**Composition & Manufacture**

Andacrib components are machine manufactured in steel moulds to ensure a consistent quality both in terms of finish and dimensional accuracy. Both headers and stretchers are fully steel reinforced and comply with the requirements of BS 8500-1:2006.

**Durability**

The high strength concrete combined with generous reinforcement cover give Andacrib structures an anticipated design life of 120 years in almost any application. The finished structures are maintenance free.
Gabions

Gabions are a series of stone filled rectangular steel baskets/cages which can form a gravity retaining wall, the mass of which is designed to resist the earth pressure. They can also be used for self-standing structures or for cladding to buildings for aesthetic reasons.

These rectangular boxes are formed from panels of wire, either using triple twisted woven mesh or square welded mesh, and both incorporate internal diaphragms and bracing wire to enhance stability and shape.

**WOVEN MESH**

Woven Mesh is ‘triple twisted’ mesh framed by thicker selvedge wires, manufactured to comply with BS1052:1980. The triple twist weaving of the wire prevents unravelling.

The Wire used in manufacture of the steel mesh is either Alu Zinc coated or galvanised to BS EN 10244-2:2001. Alternatively, Polymer coating (grey or green depending upon wire specification) provides extra protection, longer life and is applied after galvanising.

Life Expectancy of Polymer coated woven mesh in low or moderately aggressive conditions can be up to 120 years.

**WELDED MESH**

This is available in a variety of wire thicknesses finished in galvanised, Alu-zinc or PVC coated galvanised wire to suit the durability requirements of any application. Welded mesh offers more rigidity and creates a more uniform finish when erected, and is more appropriate where tight tolerances are required to the finished profile.

**STANDARD GABION SIZES**

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Other sizes and diameters available on request

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Lockstone is a modular, dry laid, interlocking, hollow, concrete block walling system which can be constructed to form complex horizontal and vertical curves.

The blocks can be filled with topsoil, gravel or concrete, and can be built with either the curved or the split face showing, depending on the required appearance and application. A variety of block colours are available. When filled with soil and planted with ground cover shrubs, the Lockstone system provides a naturally ‘green’ and aesthetically pleasing solution to slope retention problems. Geogrid reinforcement can be incorporated into the Lockstone system in order to cater for the more structurally demanding applications.
Phi Group offer a complete design, supply and installation service using drilling and grouting techniques to stabilise embankments. A large range of plant is maintained to ensure that production rates are optimised in challenging soil types and restricted access situations.

Soil Nailing

With available development land becoming ever more costly, gaining usable space on steeply sloping sites is paramount, Soil Nailing can offer the following benefits:

- Soil Nailing techniques are often an ideal solution, combined with Phi Group’s range of facing products, yielding maximum space gains whilst working safely with significant height temporary earthworks profiles.
- Using top down construction methods, with each subsequent row of nails providing both temporary and long term support, the need for costly temporary works is avoided.
- Elimination of the need for expensive stone backfill imported to site.
- Existing structures and embankments can be stabilised without rebuilding, saving costs and maintaining serviceability, for example, existing railway embankments.
- Trees, vegetation or architectural features can often remain unaffected by soil nails, as the nails can be sited to pass around or between obstacles.
Typical applications for Soil Nailing:

- Stabilising steep cuttings to maximise development space.
- The stabilising of existing over-steep embankments.
- Soil Nailing through existing concrete or masonry structures such as failing retaining walls and bridge abutments to provide long term stability without demolition and rebuild costs.
- Temporary support can be provided to excavations without the need for bulky and intrusive scaffold type temporary works solutions.
Whilst Soil Nails are an effective ground stabilisation technique, they are usually not left uncovered due to soil erosion problems and aesthetic concerns.

Phi Group’s ability to combine Soil Nailing with a variety of face treatment options, including Permacrib walls, Soil Panel and Modular Block facings will ensure that the most stringent of planning and environmental issues are satisfied. Soil Nailed slopes can also be enhanced by planting.
Soil Panel was designed and patented by Phi Group to be used specifically in conjunction with Soil Nails where the creation of extra space requires existing embankments to be cut back forming steep sloping faces. Whilst soil nailing provides the principle structural support to the cutting, Soil Panel steel cages provide a flexible facing which can provide structural support as well as facilitating an excellent finish.

The internal face of the panel forms part of the structural support to the embankment face and the outer, geotextile lined face allows filling with growing medium for vegetation establishment, or for containment of stone where required. Growing medium is then placed into the panel and is either pre-seeded or planted during the growing season.

An alternative is to fill Soil Panel with stone and this is often chosen due to restricted light locations or where a zero maintenance requirement is preferred.

Additionally Soil Panel provides excellent protection to structural elements from accidental impact or fire damage, thus enhancing durability. The technique of using Soil Panel to provide a vegetated face is protected by UK Patent.

**Benefits**
- Highways Agency approved system.
- Choice of face finishes.
- Unique, innovative system supported by full design and build service.
- Protection of structural elements in the event of collision or fire damage.
- No foundations required.
- Minimises muck away, saves on Landfill Tax.
- A system, successfully used in a wide variety of applications.
Textomur consists of horizontal geogrids or geotextiles typically at 600mm vertical centres within compacted cohesive or granular fill material. The facing to the slopes is formed using a steel mesh ‘formwork’ backed by a geosynthetic facing fabric which retains a layer of topsoil immediately behind the face. The finished slope can be hydroseeded to establish grass, or planted with appropriate ground cover shrubs. A stone face finish can also be achieved for slopes above 65°. The system is designed to BS8006 Design Code giving a 120 year design life.

**Benefits**
- Can be built with site-won cohesive fill materials. This can generate substantial savings on import of granular fill and muck-away of cohesive arisings.
- Highway services can be accommodated in the design.
- Flexibility – Can be built with curves, corners, terraces, varying wall heights and steps.
- Tolerant of differential and overall settlement – Designed to ensure that settlement of cohesive fills during compaction can be accommodated without face deformation.
- Durable - 120 year design life.
- Quick to construct with no structural foundation required.
- Construction is entirely from behind the face of the slope, and no temporary propping is required.
- Variety of face angles and finishes can be specified.
- Leading edge protection system used during construction.

**Where to use Textomur**
- Forming steep face cuttings and embankments for Highway widening schemes.
- Slopes for railway schemes.
- Environmental and acoustic bunds to screen industrial installations.
- Repairing failed slopes.
- Extending site areas to maximise plateau space for new commercial developments.

**Specification**
Textomur facing components are 5m long and are manufactured from 8 and 10mm diameter high tensile steel bars with welded connections. The standard course height is 600 mm, and the reinforcement type and length is designed specifically for each project. Face angles from 55° to near vertical can be achieved. The fill material used with the reinforcing grids is specified as Class 7B/7C/7D (cohesive) or class 6I/6J (granular) in the Department of Transport Specification for Highway Works series 600.
Phi Group can design and construct slopes up to 50° using a combination of reinforcement geogrids or geotextile reinforcement within the fill material and a cellular face matting to contain and support the topsoil on the face of the slope. Cellular face matting can also be used in conjunction with soil nailing where nailing is the best choice for slope reinforcement.

Phi Group is free to select the most appropriate soil reinforcement materials for the specific project circumstances. This results in the most economical solution without compromising technical performance.

Phi Group can either provide the internal stability calculations for incorporation into a Geotechnical Engineer’s overall slope design or complete the total design package to suit our client’s requirements.

**Benefits**
- Provision of a natural vegetated face finish.
- Economic solution for creation of additional development space.
- Can be designed using site-won cohesive fill materials.
- Cellular face matting can be used with either soil nailed cut slopes or reinforced soil fill areas.

**Where to use Reinforced Soil**
- Motorway widening schemes.
- Railway embankment strengthening.
- Commercial and housing developments creating more space.
- Lagoons and balancing ponds.
- Noise bunds.
The Geolock system comprises dry laid concrete blocks working in combination with reinforced soil.

The blocks have a positive connection with the reinforcement, which can be geogrids, geotextiles, soil nails or soil anchors, whichever gives the most economical solution. A variety of face finishes and wall face angles are available, and a simple tie detail can also be used to allow the geolock wall to be faced with masonry or natural stone work.

Phi Group is the most experienced specialist in the UK in both the design and installation of modular block wall systems. Since 1994, we have been responsible for the design, supply and construction of over 50,000m² of wall. This has included some of the most prestigious projects in the country where innovative design and technical competence have fully satisfied the visions of discerning clients.

Architectural Features
- Split or weathered finishes give the appearance of natural stone in a variety of colours with heavy texture and deep shadows to suit any environment.
- Careful use of fair faced or recessed blocks provide options to create architectural features such as banding and patterns.
- Graceful curves as well as sharp corners can be formed to suit the site layout and add further feature to the walls.
- Cladding blocks can be provided for use on adjacent structures or surfaces to give continuity of appearance.
- Blocks can be supplied that match architectural masonry.
- The tops of modular block walls can be neatly finished off with coping units either in a matching or contrasting finish.
The use of precast concrete panels, with galvanised steel strip reinforcement to strengthen the soil behind, is a well-established technique.

The rectangular concrete panel system maximises the benefits resulting from reinforced soil by providing:
- A cost effective solution typically 50% of the cost of a reinforced concrete retaining wall.
- A robust structure that can accommodate high working and dead loads associated with bridge abutments and other large retaining walls.
- A mortar free facing and self-draining system.
- A construction method requiring no structural foundation, with all work carried out from behind the panel facing.
- An end product with no curing or shutter stripping involved.

**Specification**
The standard concrete panel measures 2.0m x 1.8m. The steel reinforcement strips, normally 50mm wide by 4mm thick, are hot dipped galvanised to give a design life of 120 years. Steel strips are ribbed if necessary to increase frictional resistance within the fill material.

**Where to use the Concrete Panel System**
- Bridge abutment and wing walls.
- Heavily loaded vertical retaining walls on transportation and industrial projects.
Phi Group is the largest retaining solution specialist in the UK. Designing, supplying and building retaining structures including timber crib and concrete crib retaining walls, soil nailing, soil panels, modular block reinforced earth systems, concrete panel faced reinforced soil and planted/grassed reinforced soil slopes, all offering significant cost savings over traditional methods.

A complete service is offered including design, supply and construction undertaken by our in house Chartered Engineers and backed up by full indemnity insurance. Based in Cheltenham with regional offices in Wetherby and Dunfermline the company is at the forefront of retaining structure technology balancing engineering demands with environmental consideration. Phi Group’s own directly employed experienced construction teams, operate nationwide completing the total design, supply and build package, thus affording, optimum peace of mind and minimum risk, to client and contractor alike.

International
Phi Group welcomes enquiries for projects outside the UK. A network of specialist distributors and other Keller Group organisations operate in over 30 countries worldwide.

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