Project Harrier
DIRFT II, Daventry

Phi Group

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Project: Project Harrier, DIRFT II, Daventry

Principal Contractor: VolkerFitzpatrick

Client: Prologis on behalf of J Sainsbury plc

Contract Value: £2.3 Million

Face Areas: 11,070m²

Project Overview

VolkerFitzpatrick are the Principal Contractor responsible for the delivery of one of the largest distribution warehouses in the UK, at over 1,000,000 m^3, for Prologis. The warehouse will then be leased by J Sainsbury plc. This large project not only involves the construction of the warehouse and associated facilities, but also the installation of a new railhead to serve the warehouse. As can be seen from the picture below, the existing railhead terminates at the Tesco distribution warehouse on the other side of the busy A428. To facilitate the installation of the new railhead, a new bridge across the A428 would be required. The governing factor for the project and particularly the new railhead, was that existing ground levels were some 9.0m lower than they needed to be. This would involve the design and installation of a bund to raise levels whilst also accommodating the new rail head and heavily loaded RC slab that would be used for the unloading of containers from the trains. This RC slab would have to support heavy loadings from the reach stacking machines and HGV traffic. Beyond the new railhead a further 5.0m bund was required to completely screen the site from future residential developments. At an overall height of 14.0m and length of 800m, space constraints on site meant that there was not enough room available within the development footprint for a free standing bund with shallow self-supporting slope angles.

View of the site from the adjacent Tesco Distribution Warehouse

The Solution

VolkerFitzpatrick quickly realised that the construction of such an engineered structure firmly lay within the remit of a specialist such as Phi Group, Keller Limited's specialist retaining structures division. Although the project started on site in December 2013, discussions started between Phi Group and VolkerFitzpatrick as far back as early 2012.

The bund was originally designed as a vertical reinforced earth structure with a concrete panel facing. Phi Group design and install such systems but quickly identified that this would have required the importing of vast quantities of granular material to form the reinforced soil block, whilst also increasing the amount of material that would have to be removed from site. Through discussions with VolkerFitzpatrick, Phi Group quickly realised that the key aspect of making the project viable from an economic perspective, was forming the bund using material won from site excavations, thus limiting importing of material and cart away costs.

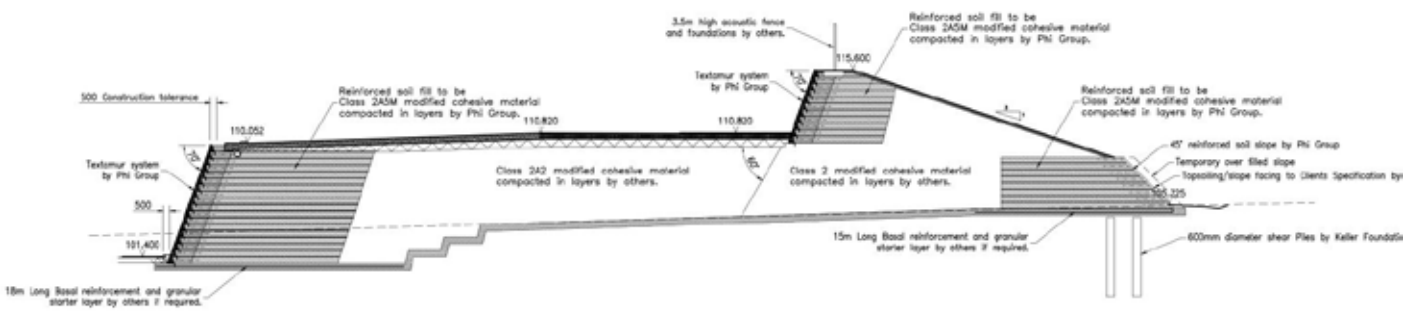
The material on site was mostly over-consolidated medium to high plasticity Lias CLAY material. This material typically has low phi values, high moisture content and high plasticity. This makes it largely unsuitable for use as reinforced soil fill material. When considering whether site won material can be used within reinforced earth designs, additional testing is recommended. Moisture content and ability to compact the material adequately are very important.

To make the site won Lias CLAY suitable for use within the reinforced soil bund, Phi Group and VolkerFitzpatrick proposed the use of Lime Stabilisation techniques to improve the parameters of the Lias CLAY. Lime is introduced to the CLAY material on site and mixed by using large rotovators. The introduction of the Lime reduces the moisture content of the CLAY material and improves it strength characteristics. This makes it both better from a design perspective, but also makes it easier to work with and compact. This is essential in the design and installation of reinforced soil structures as the material is compacted in layers around the geogrid reinforcement. VolkerFitzpatrick used an adjacent field as their treatment area, where the excavated material was prepared. The material was then delivered to our working area for use within the bund. Prior to this Lime stabilised material being delivered to us, Ground Granulated Blast Furnace Slag (GGBS) was also added to the material. This acts as a cement substitute and hardens the material further. It acts slowly, but does mean that once it is added the treated material has to be used within 72 hours. The success of the project was very much dependant on this lime stabilised material being treated and delivered to us in sufficient quantities for us to meet the agreed programme. At full speed we were able to place and compact up to 5,000m^3 of this material per week. Each layer of this material was tested for moisture content and compaction to ensure quality was maintained. Both the treatment and use of this lime stabilised material is very weather dependent. If rain was expected then there was no use in treating the material as when it gets wet it reverts back to its original state.

As the lime stabilisation increased the pH level significantly, a geogrid that was capable of withstanding these high pH levels was required. In the short term the pH levels were increased to 12.5, but reduced to 11 after just 48 hours. At maximum height the length of the geogrid reinforcement extended 13m from the face of the Textomur structure. The length of the geogrid reinforcement is determined by loadings, foundation soils, retained height and the characteristics of the material to be used as the reinforced soil fill.

Lime being placed to improve the parameters of the clay material on site.

Typically vertical structures such as the modular block or concrete panel reinforced earth systems, do not lend themselves well to the use of this cohesive material, and thus require the importing of huge quantities of 6I/6J granular material. This obviously would increase the cost of building the bund, but also increases the amount of vehicle movements to and from site. Therefore, Phi Group proposed the use of their Textomur system, installed at an angle of 70°. From initial drawing work and designs, it became apparent that there was enough room to accommodate the 70° angle. This system has a galvanised steel mesh panel that forms the front face, and was also widely used on the Olympics. It has 120 year design life and is maintenance free. The front face of the Textomur panel is then filled with a gabion stone to provide a gabion style finish. The majority of the facing stone came from an existing concrete service yard on site that was removed and crushed to the required size.



Galvanised Textomur cages prior to filling with recycled crushed concrete.

Treated material was placed and then compacted with a 13T roller in specified layer depths. To the right, one of the monitoring stations can be seen within a concrete manhole ring.

These were used to measure settlement whilst the bund was being constructed, upon completion and prior to the installation of the service slab.

Structures Completed

Intermodal Wall retaining railway and loading yard
70° Textomur wall 9.0m high x 800m long
Face Area 4,075m^2

Railway wall acting as visual and acoustic barrier to loading yard
70° Textomur wall 5.0m high x 800m long
Face Area 2,245m^2

Landscape wall retaining base of the west side of the embankment
45° wraparound reinforced earth slope 5.0m high x 800m long
Face Area 2,845m^2

Car park retaining wall
Andacrib concrete crib wall 3.50m high x 300m long
Face Area 970m^2

A428 Bridge abutment Wing Walls
4 No. Concrete Panel reinforced earth structures up to 6.50m high
Face Area 935m^2

Programme: 10 Months

Project Gallery

In the background the initial footprint of the bund structure can be seen. Taken December 2013

Completed Structure. Taken October 2014

Service Yard being installed on top of the Textomur Intermodal wall with the Textomur Railway wall in the background.

View from the base of the Intermodal wall from the South end.

View of the Textomur Intermodal Wall from the opposite end of the building at the Northern end.

In addition to the 70° Textomur Intermodal and Railway walls, Phi also installed several other retaining structures on site.

There are 4 no. concrete panel reinforced earth structures acting as wing walls for the bridge abutments of the new railway bridge over the A428. These concrete panel faced structures used polymer straps for the reinforcing elements.

View of the new bridge over the A428 supporting the rail head

Concrete Panel Reinforced Earth Wing Wall with new warehouse in background

Concrete panels with polymer strap reinforcement ready to be laid out

Aerial Photos

Almost 3,000m^2 of wraparound reinforced earth embankment (landscape Wall) was installed on site on the west side on the new bund. This was to create a vegetated green face to screen the site from new developments on the adjacent land. Again, the same re-engineered fill material was used.

45° Landscape wall retaining the base of the west side of the new bund, with vegetation beginning to establish.

Finally we designed, supplied and installed one of our Andacrib concrete crib retaining wallls. This wall is supporting the new staff car park. Staff will enter the new warehouse via a link bridge. The Andacrib system has a design life of 120 years and is designed to EC7 & EC2. Quick to construct and maintenance free, the system is far more cost effective compared to traditional retaining walls.

Andacrib Concrete crib retaining wall supporting the new car park.

Andacrib Concrete Crib Wall

Aerial view of Car Park

Health and Safety High Standards

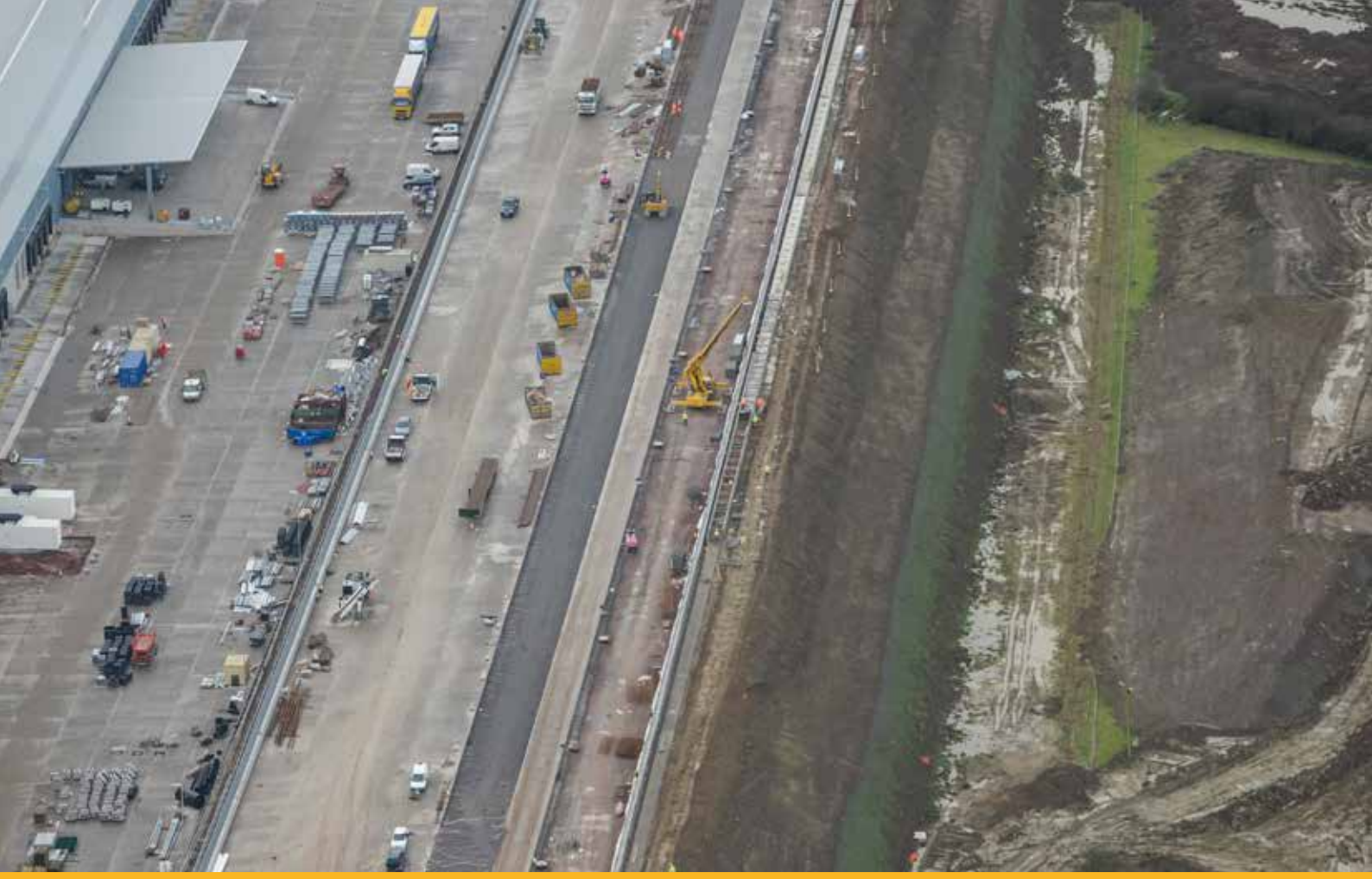
Keller have successfully implemented a number of Director Safety Tours, where company directors visit site to specifically review safety on site. These visits also apply for colleagues from other Keller Companies within EMEA. As always, Health and Safety on site is a priority for both us and VolkerFitzpatrick. Phi Group operatives were commended for their pro-active approach to Health and Safety on this project. Any feedback from these tours is given first hand by the Director involved and then relayed to all operatives on site through the daily briefings.

Keller also have a Health & Safety Award Scheme that recognises outstanding contributions made by operatives specifically in the field of Health & Safety. Following good feedback from Directors, Health & Safety Managers or directly from the Client, rewards are given. This reinforces the Keller 'Think Safe' campaign, where our Operatives are encouraged to think about Health & Safety, raise concerns and recommend how things can be improved.

About Us

Phi Group designs, supplies and installs over 300 retaining walls every year, in a challenging and demanding area of construction, using our wide range of innovative solutions. We are extremely proud of our track record, and in particular this project. Most of all we are proud of our people. All of our design is carried out in house, so we can react to changes in the Client's requirement quickly. This project was a long time in development, and a huge amount of work was required to arrive at a solution that was agreed by all involved, from both a cost and engineering perspective. We are a solutions lead company, that is able to draw on our vast design and installation experience to provide the most buildable and economic solution to requirements on site.

All of our Operatives have now gained a Level 2 NVQ Diploma in Retaining Structures. As the leading retaining wall specialist in the UK, Phi Group recognised that there was not a specific qualification in the installation of Retaining Structures. In conjunction with our partners we embarked on the process of developing such a qualification, so now as well as being CSCS Certified we have also added the specialist Level 2 NVQ Diploma Retaining Structures qualification. Phi Group are true specialists, right from the Engineers and Estimators in our offices, to our dedicated Operatives on site. At this time we are the only company to have this qualification, further evidence of Phi Group's policy of continuous development of their employees.



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