



CASE STUDY

THE PROJECT

THE HIVE INSTALLATION
BOTANICAL GARDEN

LOCATION

RICHMOND, LONDON, UK

APPLICATION

GABION AMPHITHEATRE • GABION BENCHES • ENVIROSLOPE
DESIGN • SUPPLY • INSTALLATION

DATE

MARCH 2016

CONTRACTOR STAGE ONE (UK)

ARCHITECT BUILDING DESIGN PARTNERSHIP

ARTIST WOLFGANG BUTTRESS

GROUNDWORK TRADELINE CONSTRUCTION

PROJECT BACKGROUND

The multi-award winning 'Hive' installation was designed by UK based artist, Wolfgang Buttress, whose inspiration was drawn from the latest scientific research into the health of honeybees. In particular, the bee's importance in 'feeding the planet' and by extension, the feeding of the human population. The exhibit fuses science and art into a form that enables visitors to fully immerse themselves in the story of our dependence on honeybees and the role they play as pollinators. The multi-sensory (audio and visual) experience vividly encapsulates the lives of honeybees.

At 17m tall, the structure comprises 169,300 aluminium bars joined at spherical nodes, forming a series of abstracted, honeycomb-like hexagons that spiral into the sky and contains 1,000 LED lights. Small speakers amplify the 'bee music' which is composed from 150 samples of music in the key 'C'. These samples are activated by the vibrations of real honeybees, fed via a live link from a nearby beehive.

The Hive originally formed the focal point of the UK Pavilion site at the 2015 Milan World Expo, where it won 20 awards including 'Best Lighting Design' and 'Best Pavilion Architecture Award 2015'. Following its success in Milan, The Hive was moved to a new location in London. The new setting replicates a broad wildflower meadow, in-keeping with the honeybees' natural habitat and role they play as pollinators.

Enviromesh became involved in the project through a contact at Tradeline Construction, the ground working company. Tradeline themselves had been approached by Stage One (the main contractor) to landscape the site, based on the architects' designs. Meetings



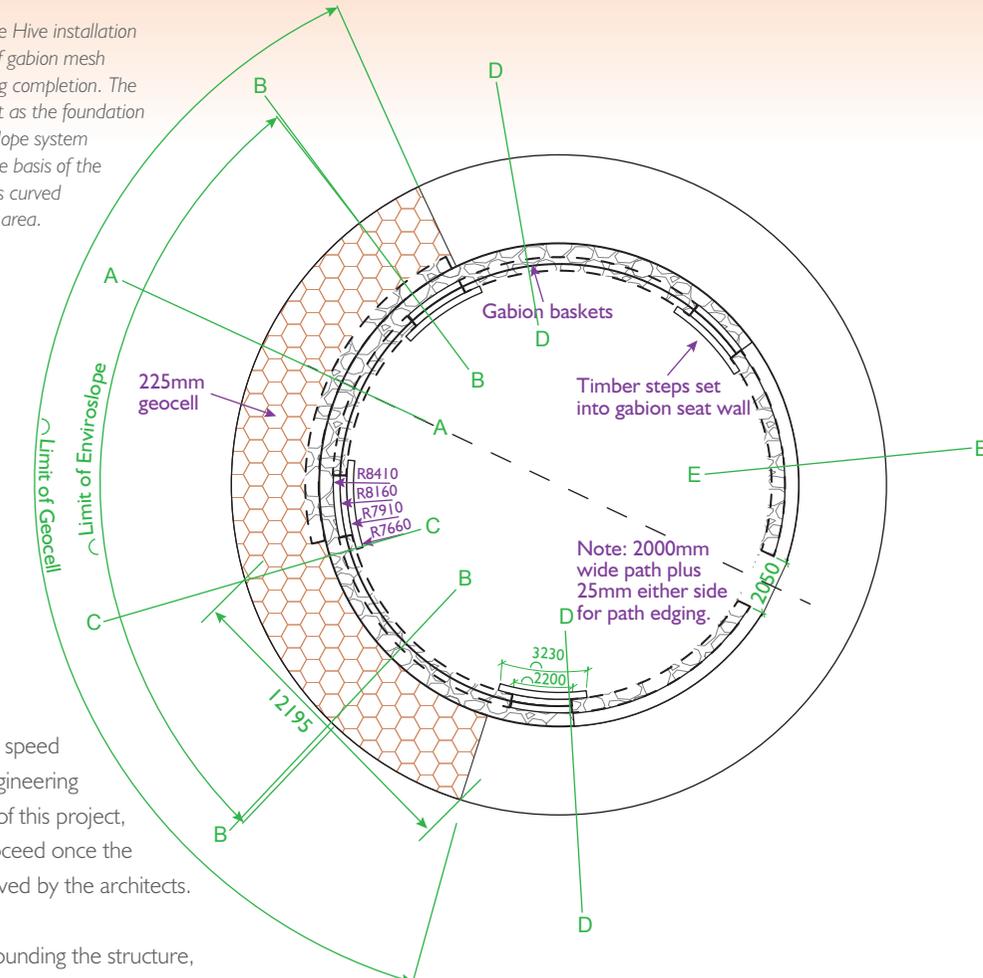
The completed 'Hive' installation, which stands sentinel at 17m high, in a setting which mimics the honeybees' natural habitat: that of a British wildflower meadow.

between the companies and the architects prior to construction, resulted in Enviromesh being asked to design, supply and install a gabion amphitheatre; the surrounding gabion benches/seating; as well as the reinforced earthworks slope retaining system, which would enable a mix of meadow grass and wild flowers to grow over it.

A number of key factors resulted in Enviromesh being awarded the contract: significant previous installation experience, a proven track record in the design and engineering of gabion solutions, and because they would be able to deliver on time. The tight project deadlines ultimately proved to be beyond the scope of other suppliers.



The site for The Hive installation with the ring of gabion mesh baskets nearing completion. The units would act as the foundation for the Enviroslope system and provide the basis of the amphitheatre's curved bench-seating area.



Plan view of the amphitheatre showing the limit of the geocell and Enviroslope systems.

THE CHALLENGES

The Hive installation presented a number of challenges that mainly related to the construction timings and those of the follow-on remedial works. The time pressures started at the design phase and continued as the various contractors moved on to site to start work.

Design

The design brief presented the initial challenge, partly because of the complexity of the reinforced earth designs and perhaps more critically, the required turnaround. Enviromesh were consulted some way in to

the planning process, which meant getting up to speed quickly. Realising the artist's vision in practical engineering terms was the singularly most important aspect of this project, but the proposed design solution could only proceed once the finalised designs had been scrutinised and approved by the architects.

The sloped, reinforced earth embankment surrounding the structure, would need to fit the overall brief not only from a design perspective, but also from a structurally supportive standpoint. The Enviroslope system would additionally be subject to the load bearing of the foot-bridge used by visitors entering the upper level of The Hive.



THE CHALLENGES

Timescales

The project's completion date and related works schedule were inextricably tied to the fixed date of the public opening. Enviromesh were given a four month window (from the original contact with Tradeline Construction and BDP to the opening date) to design, supply and install the amphitheatre's gabion wall foundation, the circular gabion wall seating system, and the surrounding earth-works and Enviroslope steel mesh faced soil reinforcement system.

Allowance would also need to be made in the overall schedule for the remedial works by the other contractors, including the laying down of hard surfaces and walkways, the stairway and footbridge access to the upper level, and the subsequent reinstatement of the surrounding landscape and planting scheme.

Multiple site contractors

The construction programme meant a number of contractors would be working on site simultaneously. The Hive structure itself would be built at the same time as the amphitheatre surrounding it.

Of particular relevance to the construction of the main structure, was the scaffolding that would need erecting around it, which would be temporarily founded within the sloped embankment and Enviroslope system. This required careful scheduling and management to ensure that neither the Enviroslope reinforcement works or the construction of The Hive itself, be unnecessarily delayed.



The gabion mesh baskets were fabricated on site and filled with 6G Kentish Ragstone such that each adjacent segment formed a singular mass gravity retaining wall system.

Each L-shaped gabion unit was designed to provide a foundation layer for the timber-clad seating on the innermost face of the circle whilst at the same time providing a solid footing behind, to help support the soil embankment and Enviroslope slope stability system.

A geotextile membrane (shown in white in the photo, left) ensured that there was no ingress of fine particles that may otherwise affect the structural integrity of the gabions.

Health and safety

As a popular and busy public attraction, the surrounding gardens would be open and fully accessible during the construction works, presenting the very real possibility of the public being in close proximity during the build phase. This raised a number of key challenges in terms of health and safety. Enviromesh addressed this through their normal procedures and risk assessments to ensure they were aware of their surroundings.

Every reasonable measure was taken to ensure both the site workers and the public were kept out of harm's way.

Delivery of heavy materials was scheduled for time slots between 7am to 10am to limit the risk involved during these times. This was further mitigated by the fact that the gardens opened at 10am.



Above, a typical section of the seating that followed the circumference of the amphitheatre, provided by the gabion mesh baskets as shown in the drawing below. The main photograph, left, shows the view from beneath The Hive at seating level. In the background, the finished embankment of the Enviroslope soil retaining system.

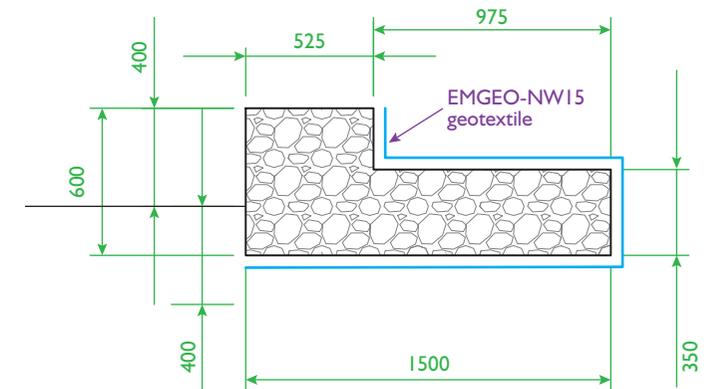
THE SOLUTION

Regular communication between Enviromesh, the architect and main contractor throughout the initial design phase, ensured the details and work schedule were fully ratified before the work started. Any questions concerning the designs were answered to everyone's satisfaction, which helped get the project off to a very good start.

A significant amount of time and thought was applied to designing and planning. The advantage of this approach, whilst time consuming,

meant that once the work had started, the fast pace of the project could be maintained. Ultimately the project's objective was to realise the artist's vision and to ensure Wolfgang Buttress would be satisfied with the final sculpture and its setting.

The Hive was constructed above a circular amphitheatre (inner radius: measuring 8 metres and the outer radius, 13 metres). The amphitheatre comprised an inner circular seating area of 8m radius, formed from a series of adjacent gabion baskets with a profiled timber-slatted surface set on top, to provide seating.



Gabion basket side elevation



ENVIROSLOPE SOIL REINFORCEMENT

The client requested an integrated reinforced earth solution for a number of reasons:

- to stabilise the embankment around The Hive,
- to provide a solid foundation for the public footbridge above the embankment,
- and to provide an effective growing medium for a wildflower meadow to be planted on the surrounding slopes, once the soil had been reinstated.

The Enviroslope solution would address all of these requirements in one very effective package.

An integrated solution

The ground levels within the amphitheatre and behind the circular seating area, rose from zero at the entrance, to a total height of 4.75 metres at the outer radius. The highest point of elevation provided the footing for one end of the walkway/footbridge between the top of the sloped embankment and the upper level of the exhibit. The design of the earth retained embankments took into account the foundation loadings from the footbridge.

At its maximum height, the embankment holding the footbridge, resulted in a variable slope angle of between zero and 45 degrees to either side of the entrance to the amphitheatre.



Taken from the upper level of the embankment, showing the walkway / footbridge access to the upper level of The Hive.

ENVIROSCOPE CONSTRUCTION

How it was done

The Envirolope earth retained embankments (which are required for slope angles between 32 degrees and 45 degrees) were designed using a combination of Envirolope facing units, geogrid ground reinforcing matrices, a 225mm geocell upper layer, and site won top soil. Gradients of less than 32 degrees did not require reinforcement.

Curvature

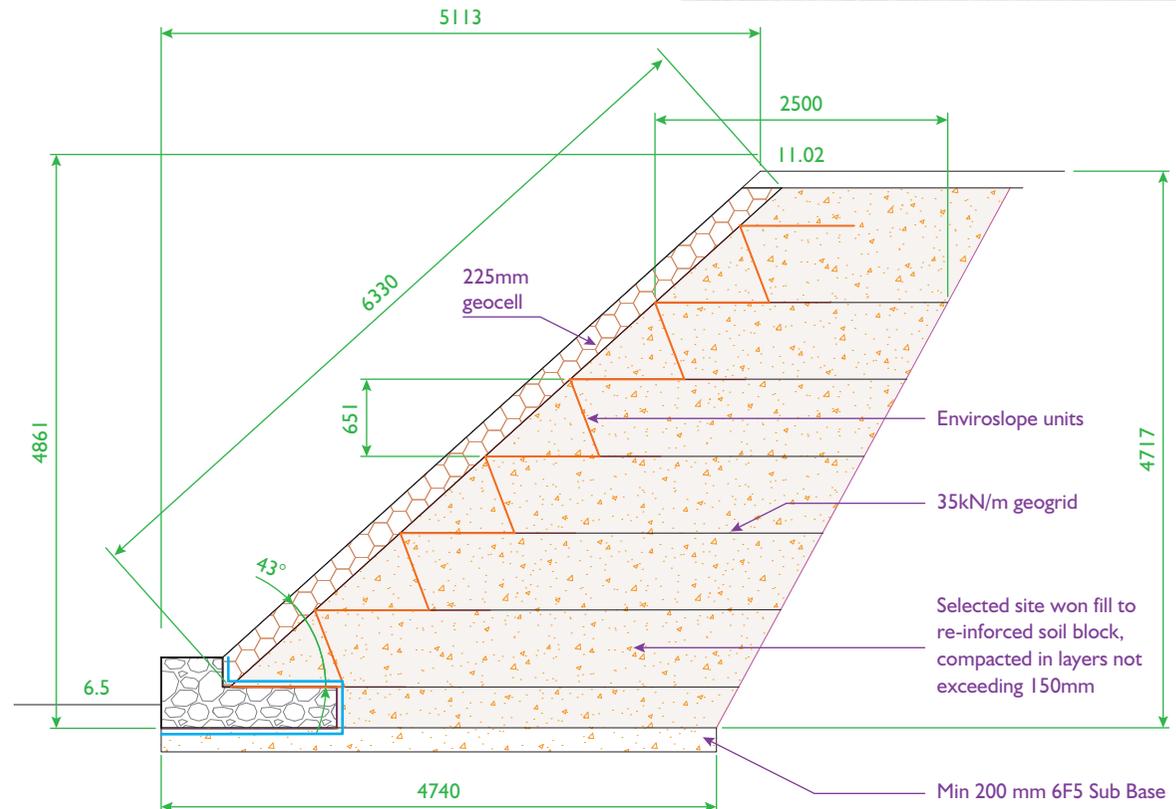
To achieve a reasonable curvature of the slope sides, the Envirolope unit lengths were determined to provide chord lengths on each lift to correspond with the overall radius of the curve.

The exposed Envirolope earth retaining system showing the gradient of the slope and the upper geocell matrix, prior to the addition of top soil.



The Envirolope units were fabricated on site as the works progressed, and are shown here, prior to their final installation and before the soil reinforced embankments were installed. These were configured as indicated by the orange 'sawtooth' lines in the drawing below.

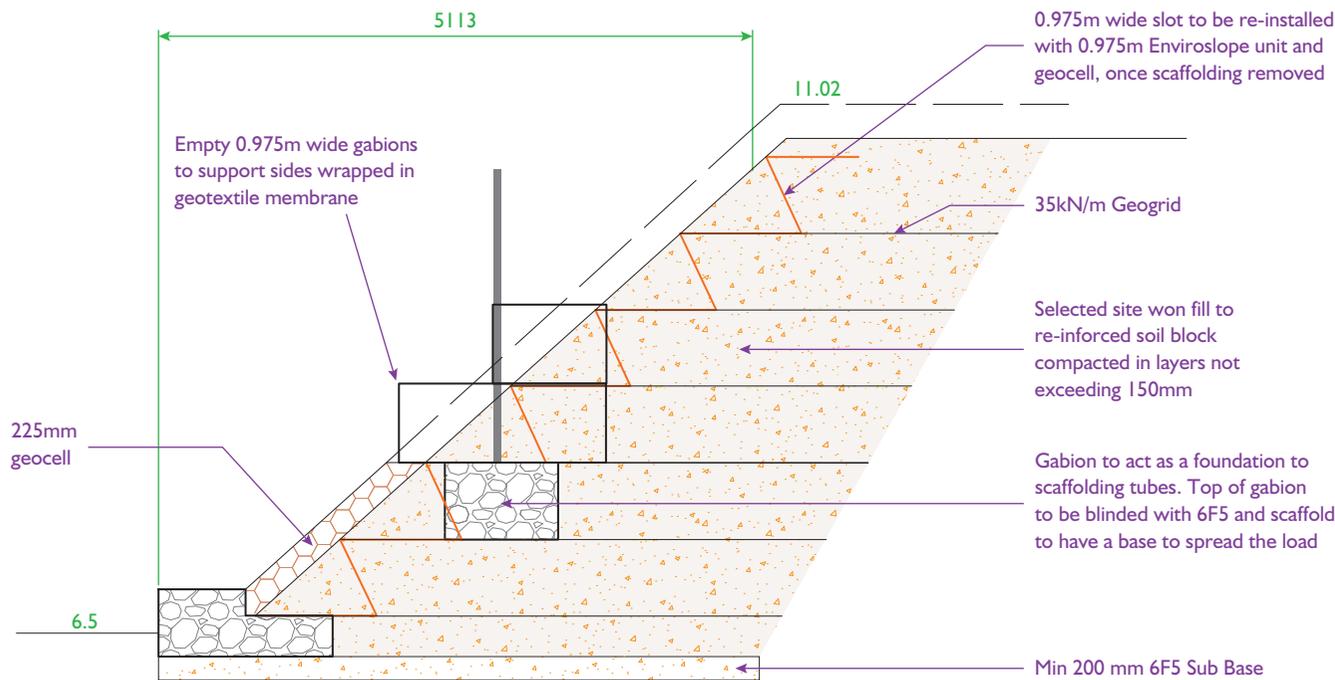
Below, the sectional drawing showing the relationship between the various components of the Envirolope system.



TEMPORARY SCAFFOLDING

The construction of The Hive required the temporary installation of supportive scaffolding. The Enviroslope reinforced embankment and The Hive would be constructed simultaneously, so a series of notches-outs were created in the face of the slope to accommodate the base plates of the scaffold (as shown in the diagram below).

Once the scaffolding had been removed, the notch outs were then in-filled. The slopes were overlaid with a 225mm thick soil filled geocell and turfed to provide a continuous and smooth curve to the finished surface, ready for over planting.



The underside of the footbridge which provided access into the upper level of The Hive, supported at one end by the Envirolope embankment.



The finished installation required supportive scaffolding during construction, which was accommodated within the sloped embankments as shown in the drawing, left.



SERVICES PROVIDED BY ENVIROMESH

- Design engineer consultations and site visits
- Quick design turnaround including detailed designs regarding the Enviroslope solution and the curvature of the gabion baskets for the amphitheatre
- Purchase, supply and delivery of 6G Gabion specification Kentish Ragstone from Gallagher Group
- Purchase, supply and delivery of geogrids from Huesker Limited
- Purchase, supply and delivery of geocells from Wrekin Products Limited
- Dedicated and experienced team of gabion wall construction personnel
- Manufacture of the gabion mesh baskets and Enviroslope solution in line with the design and supply to site

PROJECT BUILD COMPONENTS, SUPPLIED BY ENVIROMESH

- Dedicated and experienced team of gabion wall construction personnel
- Bi-axial welded mesh gabion baskets:
75mm × 75mm welded mesh (4mm wire diameter, Galfan coated)
- 6G Kentish Ragstone, rock fill material
- 6N granular engineered backfill, imported
- 6F5 foundation material, imported
- Excavator (8T), compressor, vibrating plate, banded fuel bowser, diesel, pneumatic clipping tools, and all fixing accessories including CL50 'C' rings
- Non-woven, needle-punched geotextile membrane



The base of The Hive in its finished form, supported from below within the reconstructed wildflower meadow amphitheatre.

Technical and material specifications:

- | | | |
|---------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> • Fabric type
Galfan coated bi-axial welded mesh | <ul style="list-style-type: none"> • BS EN 10223-8:2013
Steel wire and wire products for fencing and netting (welded mesh gabion products) | <ul style="list-style-type: none"> • BS EN 10244-2:2009 (Class A)
Zinc or Galfan coated (95% Zn / 5% Al) steel wire |
| <ul style="list-style-type: none"> • Tensile strength (wire)
540 to 770 N/mm² | <ul style="list-style-type: none"> • BS EN 10218-2:2012
Steel wire and wire products (general wire dimensions and tolerances) | <ul style="list-style-type: none"> • BS EN 10218-2:2012
50 years design life |
| <ul style="list-style-type: none"> • Weld strength
75% of the minimum ultimate tensile strength of the wire | | |