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# Edinburgh Gateway

Remo Pedreschi and Hedda Bjordal

Balfour Beatty



Royal  
Botanic Garden  
Edinburgh

NetworkRail



Edinburgh Gateway is a new station on the outskirts of Edinburgh connecting the Fife railway line with the tram network.

*'The new station, in the west of the city, will help to transform travel options for passengers from Fife and the north giving them easy access to the Edinburgh tram network and the city's airport. Edinburgh Gateway is part of the Scottish Government-funded Edinburgh Glasgow Improvement Programme (EGIP) which, along with a rolling programme of electrification across the central belt, will deliver reduced journey times and increased capacity and allow the introduction of new faster and greener trains.'*

The station was commissioned by Network Rail (NR) and constructed by Balfour Beatty (BB). Work on the station commenced in April 2015 and was completed in December 2016.

The Edinburgh School of Architecture and Landscape Architecture (ESALA) was invited to propose ideas to inaugurate the station and formed a partnership with Concrete Scotland (CS) and Royal Botanic Gardens (RBGE), who were advising on the planting and landscape strategy. ESALA is renowned for research into innovative construction, including research into the use of flexible fabric for concrete formwork. Seeking to contribute to Network Rail's forward-looking vision for Edinburgh Gateway, ESALA, RBGE and CS developed a proposal for artworks and landscaping that would combine ideas on urban biodiversity, sense of place, innovative construction and community engagement. The final outcome consisted of two main parts - a series of concrete wall panels designed by local school children and a landscaping proposal including abstracted concrete 'tree' forms at the entrance to the station. All the concrete pieces used various fabric forming techniques and were produced in

the ESALA workshops, Edinburgh College of Art, the University of Edinburgh.



One of the concrete panel walls.



The completed concrete trees.

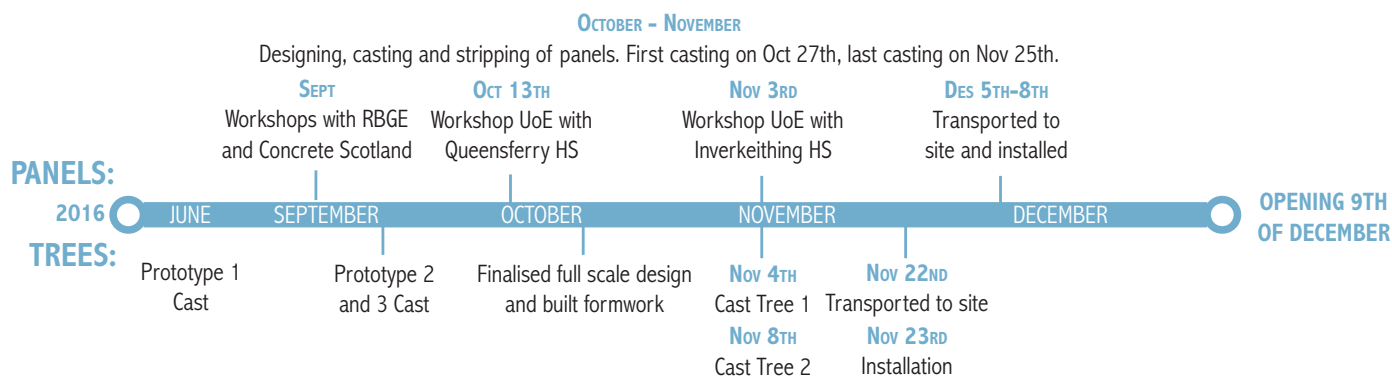
## WALL PANELS

The theme of engagement was facilitated through Concrete Scotland by connecting and involving local schools in the project. ESALA had worked with local schools before, most notably with the development of a fabric formed concrete installation at Castlevue Primary School. CS has developed an educational resource for secondary schools called 'Concrete in the Classroom'. It is intended to stimulate pupils' interest in materials and construction and involves lessons, practical projects and site visits. As a part of concrete in the classroom two schools, Inverkeithing High School and Queensferry Community High School, were invited to participate in the development of a series of decorative panels exploring the themes of



THE UNIVERSITY of EDINBURGH  
Edinburgh College of Art

EDINBURGH SCHOOL OF  
ARCHITECTURE  
& LANDSCAPE  
ARCHITECTURE



place and bio-diversity. The selection of each school was important as they represented both the north and south banks of the river Forth, which is the principal direction of the main line from the station.



**Example of wall designed by Inverkeithing High School.**

The engagement with the schools involved a series of workshops and presentations between September and October 2016. Building on earlier work with CS, each school started with a workshop on urban bio-diversity led by RBGE, followed by a second workshop on innovative concrete practice led by ESALA where the pupils were encouraged to develop ideas on the themes of place and bio-diversity. Each school attended a final workshop at the Architectural Research Workshop of ESALA, University of Edinburgh, where they worked with a group of academic staff, technical staff and PG student tutors to develop their ideas into workable panel designs.

## PANEL DESIGN AND CONSTRUCTION

Following discussions with Network Rail and Balfour Beatty it was agreed that the wall panels would be positioned under the covered walkway leading to the Gyle Shopping Centre. The canopy is supported on a single row of columns and the walkway passes on both sides. The layout of the panels was developed to suit the walkway and fit along the centre line between the columns spaced at 5 metre centres. Panels were developed in two bays, one allocated to each of the schools. A galvanised steel support frame

was installed for each bay that allowed panels to be fixed on both sides. Each of the walls consisted of two rows of panels. The upper row consisted of panels developed during the workshops and the lower row a series of key words reflecting the school ethos and the theme of bio-diversity. The final design of the installation consisted of a series of 48 panels in total. For the workshop at ESALA the pupils formed small groups of two to three and were paired with a tutor as an advisor and facilitator. They were asked to draw ideas from local features from both sides of the Forth. The tutor helped them translate their ideas into panel designs. The result was a wide range of panels utilising multiple fabric formwork techniques, drawing inspiration from everything from the iconic bridges to their favourite food – fish and chips.



**Charlie Patterson working with school children from Inverkeithing High School in the Minto House Workshop.**

The panels were made using a set of timber frames. The sizes of the panels were predetermined to suit the installation. The fabric design was stretched between the frames and fastened using staples, creating the enclosed formwork. A wide variety of fabrics and textiles were used to moderate the colour, texture and relief of the panel surface. It was not possible to complete the panels during the workshop. Further experimenting

and finalising of the designs happened throughout October and November. The panels were completed by a team of experienced PG students, with Hedda as lead tutor. Additional panels were produced to complete the layout. Many different techniques were used to get a wide variation of expressions and designs.



**Panel design inspired by plants found around a pupils house, made using stitching and different fabric textures.**



**One of the writing panels with all the foam letters removed.**

The lower row of text rich panels were initially intended to be produced using a digital fabrication process developed by Charlie Patterson. The initial results were very effective but given the number of panels needed an alternative process was developed. The text was produced from 3 mm thick plastic foam using a laser cutter. The text was then attached to the stretched fabric to create both relief and variety of finish on the surface of the panels. The letters were glued mirrored onto the stretched fabric formwork. When the concrete had sufficiently hardened and the formwork was stripped the foam letters were carefully removed leaving the embossed lettering.

## CASTING

All the panels were cast between the 27th of October and the 25th of November. The concrete mix used was developed for this project and designed specifically for fabric formwork. The mix for the panels varied but was generally in the following proportions: 1:1.5:2 (cement: sand: aggregate). A super plasticiser was used to improve workability. Conventional Portland cement and white cement were used together

with various arrangements of sand, aggregates and pigments to create a range of tones and colours in the panel designs. The panels varied from near white to dark grey in tone and blue, red and green in colour. In a couple of panels two colours were used, involving more complex casting process to preserve the colours separately. During casting two separate layers of glass fibre mesh were inserted to both reinforce the panel and improve their resistance to impact.

## INSTALLATION

The panels were fixed to the steel frame using a fixing system developed for stone cladding, suggested by Graeme Hadden (formerly of Land Engineering) and Remo Pedreschi. The self-weight of the panel was carried by a specially fabricated shelf angle bolted to the bottom chord of the frame. Each panel was secured with 4 dowels - two at the bottom and two at the top. The dowels for the panels sitting directly onto the shelf angle were pre-welded prior to galvanising. The remaining dowels were stainless steel, tied back to the frame using stainless steel brackets with isolating washers. Before the panels were transported to site they had to be prepared for installation. A trial assembly was undertaken in the Architectural research workshop to mark out and precisely drill the hole for the dowels. The panels were transported to site on the 5th of December. The assembly was finished with a set of black powder coated flashings fixed to the top, bottom and side of each face, manufactured by Martec Engineering. The joints between the panels were filled in with grey silicone to hide and protect the fixings. The installation was completed between the 5th and the 8th of December. The installation on site was carried out by Townhill Engineering.



**Installation of panels.**

## CONCRETE TREE COLUMN

The second part of the project involved the design, production and installation of large fabric-formed concrete pieces. These took the form of abstract trees and were a part of a landscaped area developed by RBGE at the west entrance of the station. The required irregular shape lends itself to the use of flexible textile formwork, which would otherwise have been difficult to produce using conventional methods. The final pieces were 4 metres tall.

### DESIGN AND CONSTRUCTION PROCESS

Firstly, the shape of the trees had to be decided. Following discussion with the RBGE and endeavouring to follow the theme of urban Biodiversity, an organic looking form produced using an inorganic material often associated with urban development, concrete, seemed relevant. The selected form was inspired by the shape of dead birch trees. As part of the development of the landscaping it is intended that plant life will inhabit and grow round the 'trees'. The shape, colour, texture and construction techniques were developed through a series of three small-scale prototypes. The final design consisted of two elements: one tree with one branch and one with two branches

The formwork was made using a stencil frame technique. The outline shape was drawn onto a pair of plywood sheets. These were then cut to follow the required profile. The shape was cut out at a 30-degree angle to the thickness of the plywood using a jig saw. The angle was deemed necessary to avoid the fabric touching the side of the ply. From this 2D shape, a 3D form was developed. The profile was then drawn onto the fabric from which a series of offset lines were developed. The fabric was attached to the plywood plates following the off-set profile. The offset lines increased the width of the fabric allowing it to fill when the concrete was poured. A woven polypropylene fabric supplied by JD Wilkies was used for the formwork. It has been used previously in several projects and was chosen for its strength and texture. The formwork was constructed in two halves, which were mirrors of each other, before moving and connecting the pieces in the casting area.



One half of the formwork for one of the trees.

In the casting area, one half of the formwork was attached to a galvanised steel base with a 320mm diameter collar and with four steel starter bars welded to the base. The base was produced in the ECA metal workshop. Steel reinforcement was attached to the starter bars and bent to follow the profile of the tree element, using the formwork as a template. Once the reinforcement was completed the second half of the formwork was erected around the reinforcement and screwed tightly to the first half.



Pouring of Tree 1.

## CASTING

The mix for the concrete comprised of white cement, 10mm white aggregate and coarse sand. This was developed during the prototype tests to produce a light sandy colour rather than a strong white. The formwork was attached to the mezzanine floor of the workshop and poured from the top. The columns were filled from the bottom up using a flexible tremie tube made in the workshop from water repellent fabric, which proved very effective. The sleeve was withdrawn as the formwork filled. The formwork was carefully rubbed to remove any trapped air. The trees were left to harden for two weeks before being moved.

## TRANSPORTATION AND INSTALLATION

It was decided to transport the columns in the formwork to provide additional support. On site the formwork had to be removed with the columns lying horizontally. This resulted in some issues when removing formwork as it was originally intended to be removed in a vertical position. Some slight damage to one edge occurred. The columns were lifted into place onto a

2m square concrete foundation using a HIAB. Firstly, the two-branched piece was positioned and the location of the bolts were marked on the concrete base. The tree was moved to the side to drill the four holes before being repositioned. The column was connected to the base using 4 20mm diameter resin anchors. The second piece was then positioned adjacent to the first and similarly installed.



Installation of trees.

The station was opened by the Transport Minister Humza Yousaf on the 9th of December.

## KEY PERSONNEL

### UNIVERSITY OF EDINBURGH

#### Project Management

Remo Pedreschi

Hedda Bjordal

Ivan Marquez

#### Workshop Staff

Malcolm Cruickshank

Malcolm Hosie

Catriona Gilbert

Esther McIntosh

#### Project Support

Fiona McLachlan

Anna Gibbons

#### Workshop Production

Ella Bayne

Katerina Alkiviadou

Lewis Lilburn

Charlie Patterson

Eleni-Ira Panourgia

Declan Goodfellow

Jeremy Steel

### PROJECT PARTNERS

#### Balfour Beatty

Brendon Donald

Gordon Shewan

Naila Akram

#### Network Rail

Kevin Knox

Ming Cole

Kirsty McKay

#### RBGE

Leonie Alexander

James Clugston

Greg Kincer

#### Concrete Scotland

Dale Lyon

### SUPPORT

Graeme Hadden (formerly of Land Engineering)

#### Martec Engineering

Keith Milne

#### David Narro Associates

#### Townhill Engineering

#### JD Wilkies

## HIGH SCHOOLS

### Inverkeithing High School

Teacher Holly Russell

Mica Fraser

Byron Blyth

Owen Braid

Emma Stark

Sean Bartholemew

Ross Gibson

Sam Heggie

Brandon McEwan

Josh McNeil

Glen Mitchell

Kyle Strachan

Ben King

Adam Smart

Dylan McMahon

Alex Graham

### Queensferry Community High School

Teacher Nicola Wilkie

Aodama Komma

Samantha Scroggie

Aiden Dowie

Travis Maclure

Adam Mansouri

Jamie Cronin

Neil Wilkies

Cameron Humphreys

Aiden Kilgallon

Brandon Brown

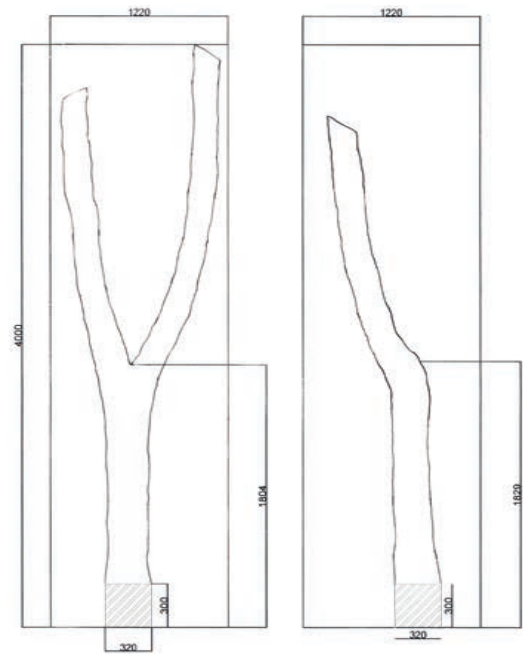
*Video about The Edinburgh Gateway by James Clugston <https://vimeo.com/199063759>*

*Video from the workshop with Inverkeithing High School <https://vimeo.com/195317594>*

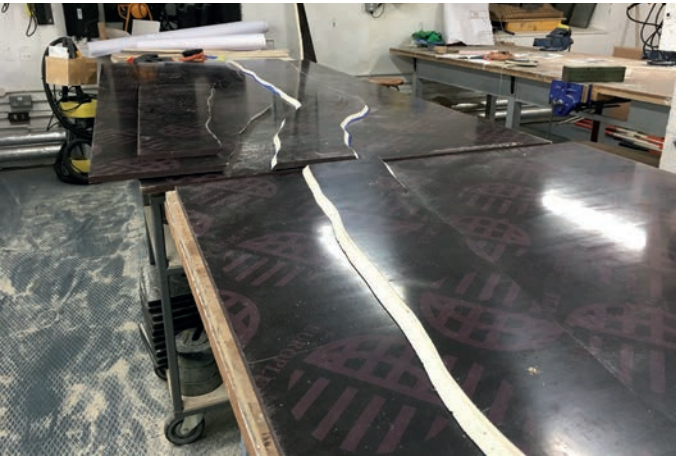
## MAKING OF THE CONCRETE TREES



From the left, prototype 2 and 3.



The formwork stencils showing the shape of the trees.



Marking and cutting of stencil. Note the angle of the already cut piece.



Fastening of fabric. The fabric was stapled all along edge of the cut-out shape.



Fitting of the reinforcement with one half of each formwork erected.



Close up of reinforcement.



Pouring of the second column.

## MAKING OF THE WALL PANELS



Students from Inverkeithing High school in the ESALA workshop.



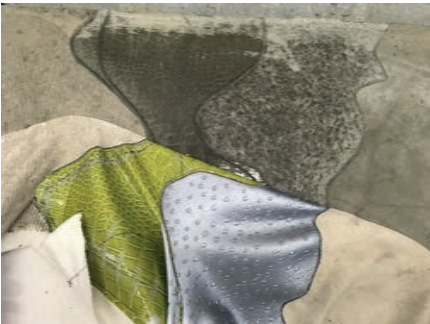
Students from Queensferry Community High school in the ESALA workshop.



Casting of the panels. The image to the left shows the glass fibre mesh.



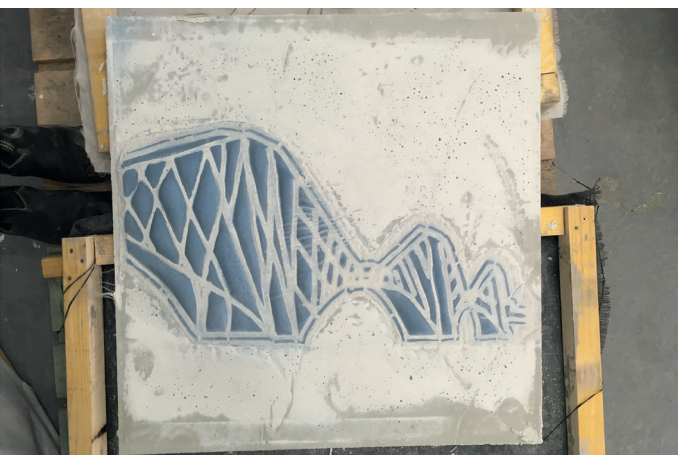
Remo Pedreschi, Hedda Bjordal and Katerina Alkiviadou with soome panel designs.



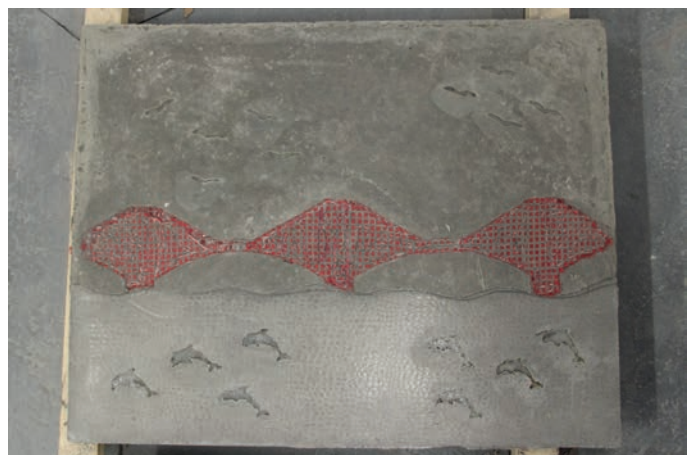
A panel design playing with the different tectures of fabric.



Before and after shot of a panel. The panel was made using a flexible fabric moulding around cardboard tubes.



A panel designed by students from QCHS.



A panel designed by Aodama and Samantha from QCHS created using different fabric textures.

## FINAL PIECES



Inverkeithing High School wall panels.



Queensferry Community High School wall panels.



The trees looking towards the station.