<table>
<thead>
<tr>
<th>CONTENTS</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRODUCTION</td>
<td>04</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>BRIDGE STRENGTHENING</td>
<td>06</td>
</tr>
<tr>
<td>2</td>
<td>JOINT REPLACEMENTS</td>
<td>07</td>
</tr>
<tr>
<td>3</td>
<td>BRIDGE JACKING</td>
<td>08</td>
</tr>
<tr>
<td>4</td>
<td>HYDRO-DEMOLITION</td>
<td>09</td>
</tr>
<tr>
<td>5</td>
<td>WATER TANKS</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>SPECIALIST COATINGS</td>
<td>11</td>
</tr>
<tr>
<td>7</td>
<td>RESIN INJECTION</td>
<td>12</td>
</tr>
<tr>
<td>8</td>
<td>GRIT BLASTING</td>
<td>13</td>
</tr>
<tr>
<td>9</td>
<td>MASONRY REPAIRS</td>
<td>14</td>
</tr>
<tr>
<td>10</td>
<td>CONCRETE REPAIRS</td>
<td>15</td>
</tr>
<tr>
<td>11</td>
<td>SPRAYED CONCRETE</td>
<td>16</td>
</tr>
<tr>
<td>12</td>
<td>WATERPROOFING</td>
<td>17</td>
</tr>
<tr>
<td>13</td>
<td>SLOPE STABILISATION</td>
<td>18</td>
</tr>
<tr>
<td>14</td>
<td>PLATE BONDING</td>
<td>19</td>
</tr>
<tr>
<td>15</td>
<td>HELIFIX SYSTEM</td>
<td>20</td>
</tr>
<tr>
<td>16</td>
<td>CATHODIC PROTECTION SYSTEM</td>
<td>21</td>
</tr>
<tr>
<td>17</td>
<td>CULVERT REPAIR AND REPLACEMENT</td>
<td>22</td>
</tr>
<tr>
<td>18</td>
<td>SITE INVESTIGATION</td>
<td>23</td>
</tr>
<tr>
<td>19</td>
<td>TEMPORARY WORKS</td>
<td>24</td>
</tr>
<tr>
<td>20</td>
<td>SERVICE DIVERSION</td>
<td>25</td>
</tr>
<tr>
<td>21</td>
<td>PRE-CAST CONCRETE</td>
<td>26</td>
</tr>
<tr>
<td>22</td>
<td>EMERGENCY RESPONSE WORK</td>
<td>27</td>
</tr>
<tr>
<td>23</td>
<td>SUSTAINABILITY</td>
<td>28</td>
</tr>
<tr>
<td>24</td>
<td>CONTACT US</td>
<td>30</td>
</tr>
</tbody>
</table>
INTRODUCTION

"OUR INNOVATIVE APPROACH TO PROBLEM SOLVING AND ATTENTION TO DETAIL CAN BREATHE NEW LIFE INTO PARTS OF OUR BUILT ENVIRONMENT"

GRAHAM Structural Solutions, formerly known as GRAHAM Structural Repairs, is a subsidiary of GRAHAM – a privately owned company which has been trading for over 200 years in both the building and civil engineering sectors.

GRAHAM Structural Solutions are widely known for their extensive knowledge and experience of concrete, masonry and steel repairs. Recent works include DRD Roads Service Term Contracts 2003-08 and 2008-12, Northern Ireland Water Service Reservoir Rehabilitation 2006-2010 and standalone projects such as the M3 Bridge Joint Replacement.

Every project is carefully planned and supervised by our highly qualified and experienced management team and is delivered by competent operatives with specialist training and skills.

Our aim is to keep business simple. We clearly understand that we win work through positive personal relationships based on:-

- GOING THE EXTRA MILE TO UNDERSTAND CLIENTS’ NEEDS & PRIORITIES
- BEING INNOVATIVE IN THE SOLUTIONS WE DEVELOP
- DELIVERING WHAT AND WHEN WE PROMISE
1 BRIDGE STRENGTHENING

Compliance with EU loading standards has necessitated a number of bridge strengthening projects. Bridge strengthening projects have included pier strengthening, steel plate bonding, hydro-demolition, concrete repairs, deck waterproofing, joint replacement and tie-bar anchoring. All our operatives are trained in many skills, and are therefore able to deliver projects efficiently.

2 JOINT REPLACEMENT

For over a decade GRAHAM has been an approved applicator of Zebrajoints (polymerised asphaltic plug joints for bridge structures). This material is capable of accommodating structural movement, thereby effectively sealing joints, and, at the same time, withstanding heavy traffic. Both structures and defective joints can be treated. In 2010 GRAHAM also became the first contractor to use Trelleborg’s Transflex Seismic Joint System in the UK and Ireland.
3 BRIDGE JACKING

Bridge jacking and bearing replacement are often required during the rehabilitation of bridge structures. In order to remove the existing beams and install new ones, the bridge deck is usually jacked up by a few millimetres using a network of hydraulic jacks.

PHOTOGRAPHS 1-3:
Jacking of the Six Mile Water Bridge enabled the GRAHAM team to access and replace the bearings. The equipment shown in both photographs is capable of jacking over 1000 tonnes.

CASE STUDY

NAME OF PROJECT: Six Mile Water Bridge, Co. Antrim
CAPITAL VALUE: £365k
CLIENT: DRD Roads Service

SCOPE OF WORKS:
Major maintenance to an existing bridge structure comprising concrete repairs to abutment walls, construction of new reinforced concrete walls in front of existing abutments, construction of new reinforced concrete diaphragm beams, replacement of all bearings and bearing plinths and replacement of all transverse and longitudinal deck joints.

4 HYDRO-DEMOLITION

This most effective system removes defective concrete without the problems of vibration and damage that are associated with the use of conventional power tools. Fully trained GRAHAM personnel can also carry out hydro-demolition to remove coatings and scale from steelwork.

CASE STUDY

NAME OF PROJECT: Glenarm Footway Strengthening, Co. Antrim
CAPITAL VALUE: £420k
CLIENT: DRD Roads Service

SCOPE OF WORKS:
Bridge refurbishment including removal of existing concrete parapet wall, construction of reinforced concrete deck and steel tubular piling, new stone parapet and reinstatement of the highway. The project included substantial temporary works to construct the deck cantilevers and parapets and maintain vehicular access over the bridge during construction.

PHOTOGRAPH 1:
Large volumes of defective concrete can be removed, and reinforcement bars left clean.

PHOTOGRAPH 2:
All hydro-demolition is fully encapsulated in order to protect operatives, the public and the surrounding environment.

PHOTOGRAPH 3:
Wire cutting is often carried out in conjunction with hydro-demolition.
5 WATER TANKS

As part of the Service Reservoir Rehabilitation Framework GRAHAM has amassed a vast range of experience working on the rehabilitation of water tanks and reservoirs. Works have included:
- Cleaning
- Joint sealing
- Concrete repairs
- Specialist coatings

PHOTOGRAPH 1: View of the interior of Hyde Park Water Reservoir.

PHOTOGRAPH 2: A 3 tonne pipe is lowered into the tank using a pulley system and specially designed temporary access.

PHOTOGRAPH 3: Replacement of defective reservoir pipework – pipes are lowered in by crane through roof of tank.

6 SPECIALIST COATINGS

GRAHAM is fully experienced in the application of decorative and protective coatings, either elastomeric or rigid depending on specific requirements. The company also uses corrosion inhibitors as part of planned preventative measures, thereby providing protection to reinforcement in all types of concrete structures above and below ground.

PHOTOGRAPH 1: GRAHAM applied a fungicidal spray followed by two high performance aliphatic protective coatings. An anti-graffiti coating completed the rehabilitation work to the NIHE building.

PHOTOGRAPH 2: A cementitious elastomeric coating was used to seal the interior of this water tank in Hydepark.

CASE STUDY

NAME OF PROJECT: Reservoir Rehabilitation Framework

SCOPE OF WORKS: Refurbishment of Water Reservoirs to prevent leakage and deterioration, and improve water quality. Internal and external works included concrete and masonry repairs, joint repairs, resin injection, waterproofing, repair of defective pipework and landscaping.

CASE STUDY

NAME OF PROJECT: Reservoir Rehabilitation Framework

SCOPE OF WORKS: Cleaning Joint sealing Concrete repairs Specialist coatings
PHOTOGRAPH 1:
Seagahan Reservoir underwent extensive repair works to remedy defective joints and cracks. A polyurethane based water-stop was injected into the drilled joints and the spillway extended to increase overall capacity.

CASE STUDY

NAME OF PROJECT: Seagahan Dam Repairs, Co. Armagh
CAPITAL VALUE: £93k
CLIENT: Northern Ireland Water

SCOPE OF WORKS: The repair of leaks from joints between blocks on the spillway at Seagahan Dam, this was achieved by pointing to the external joints (waterface) and internal joints in the masonry blockwork and resin injection into drilled holes.

CASE STUDY

8 GRIT BLASTING

Grit blasting is used by GRAHAM in the preparation of steelwork surfaces for painting purposes. Other specialist equipment is available to fulfil a similar function in relation to concrete surfaces such as decks and industrial flooring, and, where circumstances permit, high pressure water jetting can be provided as an alternative.

CASE STUDY

NAME OF PROJECT: Albert Bridge Strengthening, Belfast
CAPITAL VALUE: £418k
CLIENT: DRD Roads Service

SCOPE OF WORKS: Structural refurbishment of cast iron bridge over the River Lagan in Belfast City Centre, including the complete replacement of decorative painting. All structural works were carried out at night under lane closures.

PHOTOGRAPH 1:
Grit blasting was used in the preparation of the Albert Bridge cast iron parapets.

PHOTOGRAPH 2:
Grit blasting was used on the bridge deck sofit to remove old paintwork and rust in preparation of a new decorative paint system.

PHOTOGRAPH 3:
Grit blasting was used by GRAHAM to prepare the Albert Bridge cast iron parapets.

PHOTOGRAPH 4:
Grit blasting was used on the bridge deck sofit to remove old paintwork and rust in preparation of a new decorative paint system.

7 RESIN INJECTION

Resin Injection techniques are used by GRAHAM to resolve problems of leakage in underground car parks, basements and other water retaining structures. The resin is injected into the defective joints/cracks using a high pressure pump. It then reacts with the water in the joint to produce a compressed seal. Within a one to two day period, the crack seals and leaves the previously defective area dry.

CASE STUDY

NAME OF PROJECT: Seagahan Dam Repairs, Co. Armagh
CAPITAL VALUE: £93k
CLIENT: Northern Ireland Water

SCOPE OF WORKS: The repair of leaks from joints between blocks on the spillway at Seagahan Dam, this was achieved by pointing to the external joints (waterface) and internal joints in the masonry blockwork and resin injection into drilled holes.
Graham has successfully undertaken repair and renovation works on listed buildings, specialist projects and various bridge structures. Work has included the rebuilding, replacement and repointing of masonry work in various structures, from church spires to masonry bridges.

**9 MASONRY REPAIRS**

**PHOTOGRAPH 1:** Masonry repairs to Cushendun Bridge.

**PHOTOGRAPH 2:** Culvert Repair and Masonry Parapet Construction.

**PHOTOGRAPH 3:** Masonry repairs to historic ornamental sandstone pillars and arches.

**CASE STUDY**

**NAME OF PROJECT:** Fortwilliam Arches, Belfast

**CAPITAL VALUE:** £122k

**CLIENT:** DRD Roads Service

**SCOPE OF WORKS:** Masonry repairs to historic ornamental sandstone pillars and arches located at the East and West ends of Fortwilliam Park.

**10 CONCRETE REPAIRS**

As approved applicators for leading manufacturers of repair materials, the GRAHAM team of fully trained personnel has carried out concrete repairs on a wide variety of structures from bridges to multi-storey flats. These operations have included defective concrete removal, surface preparation, levelling, pore filling, mortar works, application of crack-bridging anti-carbonation coatings, underwater concreting, in-situ concrete pouring and the installation of pre-cast units.

**CASE STUDY**

**NAME OF PROJECT:** Red Arch Bridge Repairs, Coast Road, Co. Antrim

**CAPITAL VALUE:** £80k

**CLIENT:** DRD Roads Service

**SCOPE OF WORKS:** Removal and repair of areas of honeycombed concrete, cutting out and replacement of any corroded reinforcement bar, application of sprayed concrete to arch soffit and coating the sandstone abutments and arch soffit with a clear silicone based protective spray.

**PHOTOGRAPH 1:** Red Arch Bridge soffit on completion of concrete repairs.

**PHOTOGRAPH 2:** Concrete defects at Red Arch Bridge.
## 11 SPRAYED CONCRETE

Masonry and concrete structures can be repaired by GRAHAM’s in-house team using dry or wet sprayed concrete techniques.

**PHOTOGRAPH 1:** Concrete spraying to the deck soffit of a masonry bridge in Antrim.

**PHOTOGRAPH 2:** A steel mesh was attached to the arch soffit after cleaning and minor concrete repairs. Weep holes were cut through the mesh and concrete sprayed onto the surface.

**CASE STUDY**

- **NAME OF PROJECT:** Drumnafivey Bridge Refurbishment, Co. Antrim
- **SCOPE OF WORKS:** Temporary river diversion, minor masonry repair, concrete spraying to arch soffit and rehabilitation of surrounding environment.
- **CAPITAL VALUE:** £5k
- **CLIENT:** DRD Roads Service

## 12 WATERPROOFING

Waterproofing of structures is included in many of the rehabilitation projects that GRAHAM is involved with. GRAHAM has a vast knowledge in this area and can offer waterproofing solutions for a variety of problems on both a small and large scale. All waterproofing membranes used by the GRAHAM team are gas retardant and suitable for inclusion on works with radon problems. Specialist membranes can also be sourced through GRAHAM.

**PHOTOGRAPH 1:** Waterproofing and resurfacing of Lifford Bridge.

**PHOTOGRAPH 2:** Waterproofing of a small box culvert wall.

**PHOTOGRAPH 3:** Waterproofing to the bridge deck.

**CASE STUDY**

- **NAME OF PROJECT:** Lifford Bridge Refurbishment, Donegal
- **SCOPE OF WORKS:** Waterproofing to the bridge deck.
- **CAPITAL VALUE:** €76k
- **CLIENT:** Donegal County Council

**CASE STUDY**

- **NAME OF PROJECT:** Lifford Bridge Refurbishment, Donegal
- **SCOPE OF WORKS:** Waterproofing to the bridge deck.
- **CAPITAL VALUE:** €76k
- **CLIENT:** Donegal County Council

**CASE STUDY**

- **NAME OF PROJECT:** Lifford Bridge Refurbishment, Donegal
- **SCOPE OF WORKS:** Waterproofing to the bridge deck.
- **CAPITAL VALUE:** €76k
- **CLIENT:** Donegal County Council
13 SLOPE STABILISATION

GRAHAM has worked on many projects involving slope stabilisation solutions. Depending on the severity of the slope failure, different methods have been employed to remedy the situation including:

- Piling
- Gabion Walls
- Anchor Ties
- Reinforced Soil System

PHOTOGRAPH 1&2:
Skerry East Retaining Wall. A gabion wall is constructed to act as a retaining wall to the road above.

PHOTOGRAPH 3:
To secure the rock face at Garron Point, operatives abseil down the cliff face, drill holes into the rock, insert tie bars and attach a steel mesh to stop debris falling onto the road below.

CASE STUDY

NAME OF PROJECT: Garron Point Rock Clearance, Coast Road, Co. Antrim

SCOPE OF WORKS:
Closure of the A2 Coast Road, removal of loose rock from the cliff face and installation of protective mesh

CAPITAL VALUE: £105k

CLIENT: DRD Roads Service

14 PLATE BONDING

Steel and carbon fibre plate bonding contracts have been successfully completed to strengthen structures. GRAHAM was the first company in Ireland to use carbon fibre for plate bonding, and the product has been applied to enhance the load bearing capacity of road bridges and to carry out remedial works to fire damaged buildings.

PHOTOGRAPH 1:
Completed installation of bonded plates to one of the deck soffits of the Saintfield Road Bridges.

PHOTOGRAPH 2:
Bonded plates used to strengthen Glenarm Bridge.

CASE STUDY

NAME OF PROJECT: Saintfield Road Bridges, Lisburn, Co. Antrim

SCOPE OF WORKS:
Installation of safety barriers, concrete works, waterproofing, bridge strengthening and resurfacing works.

Bridge was strengthened by application of steel plates, bonded to the soffit of the bridge decks.

CAPITAL VALUE: £350k

CLIENT: DRD Roads Service

PHOTOGRAPH 1:
Completed installation of bonded plates to one of the deck soffits of the Saintfield Road Bridges.

PLATE BONDING

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### 15 HELIFIX SOLUTIONS

Helifix Crack Stitching is a technique used to repair and strengthen cracked masonry. Helibars are bonded into the bed joints or purpose saw cut slots to act as tie-bars. They stabilise the defective masonry and re-distribute tensile loads to minimise further deterioration.

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<tr>
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<th>Scope of Works:</th>
<th>Capital Value:</th>
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<td>HELIFIX SOLUTIONS – Kells, Co. Antrim</td>
<td>Site investigation, erection of temporary works, installation of Helifix solution to tie in masonry arch ring.</td>
<td>£10k</td>
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**Photo 1:** Extreme settlement cracks at a domestic property in Kerry. A tell-tale was installed to monitor the amount of movement before a helifix solution was installed.

**Photo 2:** The arch ring of a masonry bridge near Kells started displaying signs of failure. GRAHAM used the Helifix technique to tie the arch ring back into the main structure.

---

### 16 CATHODIC PROTECTION SYSTEM

Cathodic protection is a technique whereby a substance more susceptible to corrosion is attached to a structure in order to protect the integrity of the main structure. This technique is often used to protect steel structures located close to or in water e.g. bridges.

<table>
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<tr>
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<td>VICTORIA BRIDGE REHABILITATION – Co. Londonderry</td>
<td>The complete rehabilitation of Victoria Bridge including traffic management, survey work, concrete repair, APJ replacement and the installation of cathodic protection.</td>
<td>£45k</td>
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**Photo 1:** Sacrificial anodes were placed at regular intervals across the reinforcement cages in the bridge deck at Glenarm.
17 CULVERT REPAIR AND REPLACEMENT

A considerable number of structures that GRAHAM have been contracted to repair have been in such a bad state of disrepair that it is more economically advantageous to the client to replace the entire structure. Box culverts are often used for this purpose.

PHOTOGRAPH 1:
Several box culverts can be used to accommodate larger spans.

PHOTOGRAPH 2:
Replacement box culvert at Patterson’s Hill.

NAME OF PROJECT: Tamliagh Bridge Replacements, Co. Fermanagh
CAPITAL VALUE: £50k
CLIENT: DRD Roads Service

SCOPE OF WORKS:
The complete replacement of the Tamliagh Road Bridge including river diversion, culvert replacement and the construction of masonry stone walls.

18 SITE INVESTIGATION

GRAHAM undertakes initial investigations, culminating in structural fault diagnosis and situation reports. Recommendations are submitted in respect of repair operations, ranging from minor cosmetic works to full replacement and strengthening of concrete, steel and masonry structures.

PHOTOGRAPH 1:
A hanging scaffold system was erected on the Lifford Bridge in order to survey the condition of the underside of the bridge deck.

PHOTOGRAPH 2:
A diver was used to carry out underwater surveys on the Glenarm Bridge Strengthening Project.

PHOTOGRAPH 3:
A self supporting scaffold system was erected to investigate the extent of repairs required to strengthen the arch barrel of Glenshesk Bridge.

A TYPICAL SITE INVESTIGATION INCLUDES:
- Concrete compressive strength
- Reinforcement yield strength
- Depth of carbonisation
- Concrete chloride content
- Cover depth of reinforcement
- Iso-potential plots, based on half-cell measurements, to locate areas most likely to support corrosion
- Environmental Impact Study

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- Environmental Impact Study
19 TEMPORARY WORKS
Temporary works are of extreme importance during a construction project. Not only do they provide access to working areas but also support imposed loads during construction act as a safe working platform for operatives. GRAHAM has a vast knowledge of working platforms and temporary works and can provide innovative scaffolding solutions.

PHOTOGRAPHS 1&2: Hanging scaffolding provided access to the unstable parapet walls for strengthening on the Rock Bridge.
PHOTOGRAPH 3: Scrabo Tower was fully encapsulated by scaffolding.

NAME OF PROJECT: Scrabo Tower, Newtownards, Co. Down
CAPITAL VALUE: £418k
CLIENT: DoE Historic Monuments
SCOPE OF WORKS: Pressure grouting, two stage lime mortar repointing, resin injection and sandstone replacement conservation works.

20 SERVICE DIVERSION
Very often during repair work, existing services need to be diverted in order to provide a safe working area for the construction team as well as to minimise disruption to surrounding areas. GRAHAM has a long history of diverting services safely and effectively with minimal disruption.

SERVICES OFTEN DIVERTED BY GRAHAM INCLUDE:
- Electrical cables
- BT cables
- Sewage pipelines
- Gas mains
- Water pipes

PHOTOGRAPH 1: The positioning of existing services is firstly confirmed with the relevant authorities. The GRAHAM team can then hand excavate the area to reveal the services.
PHOTOGRAPHS 2&3: When existing services have been revealed, the GRAHAM team can then divert or protect the services from damage.
21 PRE-CAST CONCRETE

GRAHAM has formed a close working relationship with local pre-cast concrete manufacturers and is heavily involved in the development of the optimum designs. Pre-cast concrete can often offer economic advantages as well as increase the speed of construction. On the Cushendun Contract the construction time was cut by over 50% due to the use of precast deck slabs compared to the traditional in-situ deck solution proposed by the client originally.

PHOTOGRAPH 1 & 3: The Cushendun Bridge deck was formed using forty four 9 tonne precast units placed over two days.

PHOTOGRAPH 2: Each unit was transported to site immediately prior to installation.

NAME OF PROJECT: Cushendun Bridge Repair, Co. Antrim
CAPITAL VALUE: £350k
CLIENT: DRD Roads Service

SCOPE OF WORKS: Removal of cantilever deck and replacement with Pre-cast Cantilever Deck.

22 EMERGENCY RESPONSE

Accidents can and do happen. Whether they are caused by people or by weather conditions, accidents can cause considerable damage to structures and disruption to people in the local vicinity. The GRAHAM team strive to respond to any incident quickly and efficiently. Our highly skilled squads have the necessary training to assess a situation and respond in the most efficient manner possible. GRAHAM has responded to damage caused by collisions, flooding, slope failure and structure subsidence.

PHOTOGRAPH 1: Masonry parapet repairs at Muckamore Bridge.

NAME OF PROJECT: Muckamore Bridge Emergency Repair, Co. Antrim
CAPITAL VALUE: £30k
CLIENT: DRD Roads Service

SCOPE OF WORKS: After a vehicle strike to the parapet wall at Muckamore Bridge, the GRAHAM team responded to the accident by installing a temporary traffic management scheme, erecting temporary works, completing masonry repairs and bridge strengthening. This work was completed during the holiday period.
23 SUSTAINABILITY

Sustainable Development for GRAHAM is based around supporting communities in areas where we work, promoting economic regeneration, and proactively enhancing the natural environment and habitats therein. Simply put, our ethos is that of ‘Acting Today in a way that Enriches Tomorrow’ for future generations to enjoy.

BIODIVERSITY

PHOTOGRAPHS 1&2: Installation of Bat and Bird boxes made from recycled wood was one of the sustainability measures implemented at Six Mile Water Bridge. These ecological enhancements were recognised by way of nomination in the Sustainable Ireland Awards 2010.

ENVIRONMENTAL PROTECTION

PHOTOGRAPH
Where over half of our works focus on the repair of bridges over water, protection of watercourses and preventing pollution is key. Using filter membranes and encapsulating scaffolding for temporary works along with implementation of an Environmental Plan, ensures best practice above and beyond legal compliance.

SUSTAINABLE PROCUREMENT & MATERIALS

PHOTOGRAPH
After water, concrete is the most used substance on the planet so reducing its carbon footprint requires innovation. We use low carbon concrete on works to reduce CO2 emissions by over 60%, along with other Greenhouse gases and NOx emissions.

INVESTING IN OUR PEOPLE

PHOTOGRAPHS 2&3: Accredited with the Investors in People standard, we invest in our people through skills development and support for long term unemployed. Our partnering approach with local colleges, universities and the Princes Trust, along with our tailored graduate programme, and supporting the initiative ’Women in the world of engineering’, results in an all inclusive happy and healthy workforce, with increased confidence, experience and recognised qualifications.

SUPPORTING LOCAL COMMUNITIES

PHOTOGRAPHS 4&5: Working on this Water Treatment site, we combined landscaping duties with community engagement, whereby local school children and their parents planted trees to serve as a green roof.

REVIVING TRADITIONAL SKILLS

PHOTOGRAPH
We understand the need to support local small and medium sized enterprises and traditional or ‘dying’ skills to encourage economic regeneration in areas where we work. Specialist stone masons, using traditional means of restoration with reclaimed and recycled products guarantee a high quality standard of works.