

# Marine Geotechnics

Local Knowledge, Global Expertise



ARUP





# About Us

Arup is a global firm of planners, designers, engineers and business consultants. Our success is founded on understanding our clients' needs, combined with the application of leading edge technology and proven management excellence.

Established in 1946, Arup has over 11,000 employees based in more than 90 offices across 38 countries. Its unique structure, with the firm held in trust on behalf of its employees gives us complete independence. Our aim is to achieve excellence in all we do by bringing together the best professionals in the world to meet our clients' needs.

A substantial portion of the firm's income is invested every year to improve technical standards and ensure that Arup can continue to offer the latest cutting edge design and management solutions. Arup has a recognised responsibility to the environment, and is committed to sustainable design, its increasing incorporation in projects and to industry-wide sustainability initiatives.

Arup's global reach makes it simple for us to deliver a wide range of challenging work, with the flexible and efficient organisation of its staff making sure that the right people are always working on the right project, regardless of the location. A worldwide network of technical expertise, combined with local knowledge and personal service, help meet and exceed clients' expectations. Arup's work is characterised by outstanding solutions, innovation and value.

# Key Marine Ground Investigation Services



V&A Marine Ground Investigation, Dundee

Our desk study capability covers the full range of required expertise including gathering and assessing historical drawings, geology, geotechnics, bathymetry, wind and wave studies, hydraulic numerical modeling, sediment transport, marine ecology and many other related issues specific to a proposed development.

We have significant local and international experience in the design and procurement of marine ground investigations for a variety of end uses, including offshore renewables, berths, waterfront redevelopments, bridges and tunnels. Our broad client base includes government bodies, private developers and energy companies. Key to our success in this field is our relationship management with clients, stakeholders, licensing authorities and specialist contractors.

In Scotland we have developed a local, highly skilled and experienced team of engineering supervisors who not only ensure the clients technical requirements are achieved, but who are also commercially aware and act as the vital expert link between the client and the contractor, to give maximum benefit to the project. As a result, overall site productivity and the quality of the information obtained is maximised and unproductive ‘down time’ is minimised by working closely with contractors in a non-adversarial and collaborative manner.

We offer a full range of geotechnical & geoenvironmental design and interpretative reporting services which aim to provide maximum value to the client, to inform and guide the design development process.

Arup is the market leader in the provision of technical and commercial due diligence services in the offshore wind sector. We offer services to a broad range of transactions including M&A, Lender’s TA, Secondary market deals, Authority’s TA, Market Appraisals and Vendor Due Diligence.

## Specialist Technical Skills

- Maritime Engineering
- Geotechnical engineering
- Geology
- Geophysics
- Geoenvironmental

## Key Services

- Marine Geotechnical & Geoenvironmental Desk Studies
- Design & Procurement of Marine Ground Investigations
- Contract Administration
- CDM
- Marine Licencing and Stakeholder Liaison
- Project Management
- 24/7 Engineering Supervision (Client Representative)
- Geotechnical & Geoenvironmental Interpretative Reporting
- Geotechnical Design
- Marine Mammal Observation (MMO) / Marine Ecology
- Due Diligence Studies

# Understanding the Challenges and Delivering Solutions



Supervision of Simultaneous Drilling and CPT Operations in the Femern Strait, Denmark

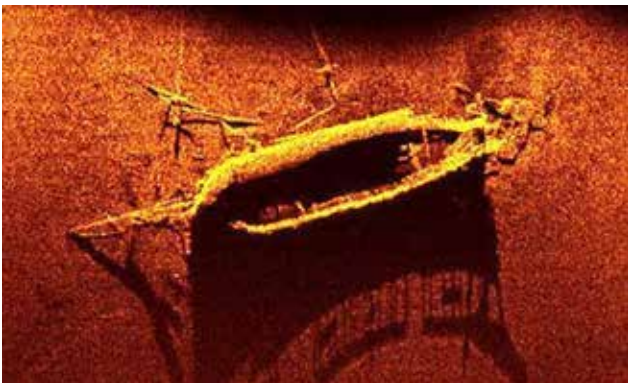
Arup recognises that Marine Civil Engineering projects typically require high capital investments and carry significant risks and challenges and therefore differ greatly from those that are land based. One of the key challenges to any project is obtaining quality and value from the marine ground investigations. Where this is achieved, it reduces project risk and provides greater client confidence and increased cost certainty with the subsequent design.

Through undertaking a significant number of marine geotechnical ground investigations, Arup have developed high levels of technical and project management skills, which are tailored to the marine ground investigation process; from initial feasibility through to detailed design. Arup's focus is to ensure that investigations deliver quality information and are undertaken in a safe and cost effective manner.

Our specialists are recognised within the marine ground investigation community with both clients and specialist contractors. We have shared our knowledge and experience within the industry through presenting at seminars organised by the British Drilling Association (BDA) and Institution of Civil Engineers (ICE).

We have the expertise and resource to provide the full range of engineering and geological services from initial concept through to detailed design. We can also provide highly trained and experienced client representative engineering supervision staff for marine ground investigation projects both nationally and internationally.

# Environmental Survey



As a multidisciplinary organisation we can ensure that both the technical and environmental objectives of the survey are met, ensuring both development and delivery risks are appropriately managed. This includes an understanding of the requirements of survey specification to meet environmental impact assessment for archaeology, benthos, coastal processes and other environmental receptors.

Our Client Representatives are trained to provide a wide range of environmental services to ensure compliance with the clients Environmental Management Plan (EMP). This includes:

- **Marine Mammals** - We have experience of working with the JNCC protocol for mitigation of noise impacts on marine mammals and can provide trained Marine Mammal Observers (MMO) who have an understanding of the regulatory and ecological context of their role.
- **Archaeology** - We have experience of working with the requirements of project specific Written Scheme of Investigation (WSI) and Protocol for Archaeological Discoveries (PAD) and can undertake supporting survey roles such as archaeological champion.
- **Commercial Fisheries** – We understand the requirement for managing relationships and interactions with local fishermen, and can provide project Offshore Fisheries Liaison Officer (OFLO) services.

We can provide offshore consenting and permitting support, providing guidance on the approvals process for a full range of intrusive and non-intrusive geo-surveys. This includes production of European Protected Species risk assessments, liaison with statutory bodies and application preparation.

# Training and Certification

The health and safety of our employees is of prime importance. In accordance with the firm's Global Health and Safety Objectives, all persons who undertake site based work must have attended an Arup General Site Safety Briefing (renewable on a three yearly basis) and have completed a Site Specific Risk Assessment and briefing before going to site.

Arup staff who perform the Client Representative role have undertaken a wide range of Industry training to allow them to perform their role accurately and in a safe and responsible manner.

The certification held by our staff include the following:

- BOSIET / MIST Certification
- Basic Sea Survival Certification
- JNCC Marine Mammal Observer



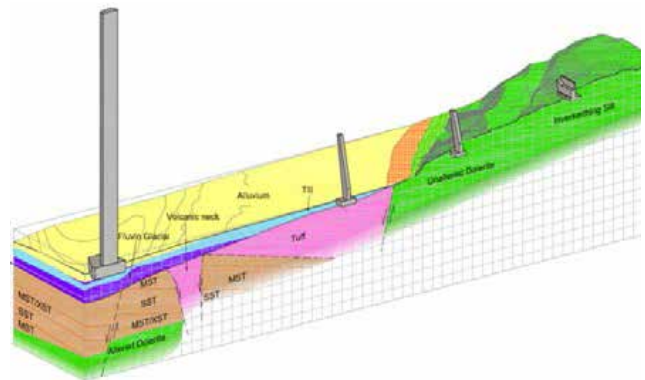
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# Forth Replacement Crossing: Marine Ground Investigations



Arup delivered a three phase £4.5M Marine Ground Investigation between 2008 and 2011 which informed the development of the foundation design for the proposed £1.6B cable-stay bridge crossing.

The team conducted detailed preliminary studies and went on to manage and supervise the £4.5M marine ground investigation contract, over three phases. The complex geology required careful sampling with specialist tests to identify in-situ strength and lithology.

The findings of these investigations were interpreted and published within a comprehensive Geotechnical Investigation Report. This report formed the basis of the design of the foundations, which were developed to meet the requirements of Eurocode 7, one of the first major UK infrastructure projects to be designed to be fully compliant.

## Client

Transport Scotland

## Key collaborators

Jacobs (Joint Venture partner)

## Key facts

£4.5m marine investigations for £1.6bn capital budget

World's longest three-tower cable-stayed bridge.

## Key services provided

Geotechnical consultancy and management services including:

- Client Advisor
- Procurement
- Full-time Geotechnical Supervision
- Environmental Licencing
- Project and Programme Management

## Awards

CEEQUAL Excellent (92.7%)



# Forth Replacement Crossing: Marine Investigation H&S



As part of their appointment by Transport Scotland for the design and procurement of the £4.5M FRC Marine Ground Investigation, Arup managed the Health & Safety of the over-water works.

As part of that commission Arup supervised the £4.5M marine ground investigation contract, including the management of the H&S aspects of these works. Procedures were developed to allow personnel and equipment to be moved and operated in this testing marine environment, made more difficult by the 24 hour 7day nature of the works. Working closely with the CDM Coordinator, Arup critically reviewed the Contractors method statements, which included liaison with maritime agencies and port authorities. Particular attention was paid to the identification of appropriate marine safety training and appropriateness and compliance of safety equipment. During the works, adherence to agreed procedures was monitored; with the Contractor required to up-date site safety briefings and procedures to reflect any changing working methods.

## Client

Transport Scotland

## Key collaborators

Jacobs (Joint Venture partner)

## Key facts

With the support of Transport Scotland, many of the systems for H&S auditing developed by Arup during the marine ground investigation will be carried forward into the far larger construction stage.

## Key services provided

The works involved the use of large jack-up barges in deep coastal waters in close proximity to busy shipping lanes.

# Femernbaelt Fixed Link, Denmark & Germany



Numerous Jack-ups and Guard Vessels in Femern Strait

Arup provided a team of specialist Geotechnical Engineers & Geoscientists to undertake site supervision support services for the extensive marine ground investigation works on this major international civil engineering project.

The Ramboll Arup JV was appointed by the client Femern A/S (Danish Government) to design and supervise Marine borehole and CPT investigations to depths of 100mbgl for the proposed new 20km length Fixed Link crossing between Rodby in Denmark and Puttgarden in Femern, Germany. The ground investigation works were undertaken over two summer campaigns between 2009 and 2010 with site supervision support services provided by an Arup team of specialist Geotechnical Engineers. Although the initial request for assistance was to provide site supervision cover for a period of three weeks, the client recognised the value of having experienced and qualified staff on site and subsequently requested that Arup extend the scope of services to provide full-time supervision for the full duration of the GI works and subsequent large scale testing operations over both investigation campaigns and beyond.

## Client

Femern A/S (The Danish Government)

## Key facts

Proposed 20km Immersed Tube Tunnel to link Denmark and Germany (Rodby in Denmark – Femern in Germany)

€5bn Project Value

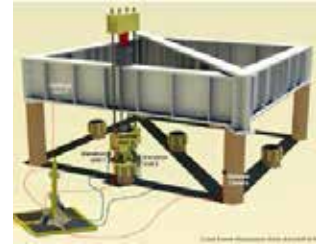
## Key services provided

Marine Geotechnical Engineering

- 24/7 Full Time Engineering Supervision for two drilling campaigns over two years
- Full Time Underwater pile installation and testing supervision
- Full time supervision of test excavation dredging

# Femernbaelt Fixed Link, Denmark & Germany

In addition to the supervision of the marine ground investigations, Arup were also requested to assist with the engineering supervision of marine bored cast in place and driven pile installations and associated underwater pile testing undertaken as part of a combined study between Femern A/S and the Norwegian Geotechnical Institute (NGI). This study and scope of supervision works also included a Large Scale Test excavation to simulate the dredging element of the tunnel design. This trial allowed the rates of production in the Paleogenic clay and the cut slope stability to be established. Extensometers were also installed at the base of the 70m x 30m test excavation to monitor heave. The excavation was undertaken in a phased approach over a period of 2 years. Underwater pile tension testing was also undertaken as part of this project and Arup staff supervised the set up of the pile test frames and also the underwater pile tension tests.



Underwater Pile Test Set Up



Logging of Cores



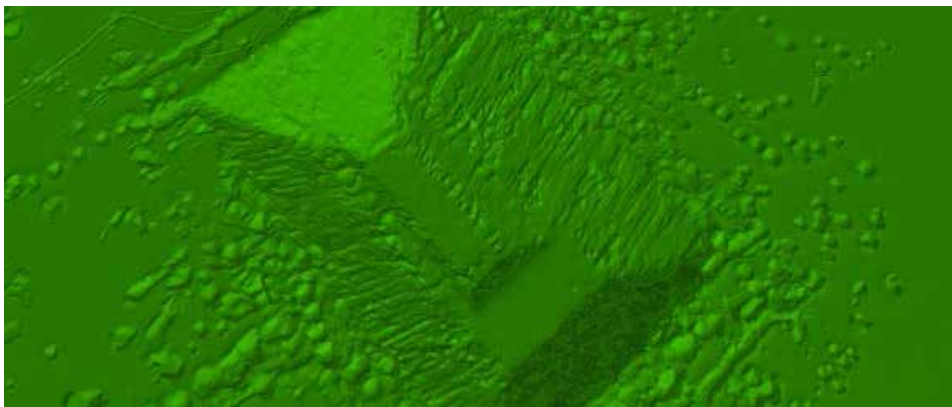
Installation of Driven Piles



Jack Up Drilling Platform in Lillebaelt



High quality core recovery



High Resolution MBES Survey of Underwater Test Excavation



Installation of referencing device for pile testing.

# Port of Leith, New Outer Berth for Marine Renewables



Jack Up Drilling Platform

Efficient and focussed project management by Arup allowed investigations comprising marine drilling, vibrocoreing, sea bed grab sampling, met-ocean data collection and bathymetric surveying to be undertaken over the same investigation window within demanding project timescales.

Arup, acting on behalf of the client produced a detailed desk study of the site and designed, procured and supervised full-time the marine ground investigations for the new Port of Leith Outer Berth development adjacent to the existing Forth Ports operated Port of Leith in Edinburgh.

Arup managed the procurement process on behalf of the client and were responsible for obtaining all necessary permissions and consents to allow the investigations to be undertaken. This included conducting detailed utility and services searches, liaising with the Port operator Forth Ports and obtaining a Marine Scotland and Crown Estate Licence for the investigations.

## Client

Scottish Enterprise

## Key facts

The proposed development comprises the construction of a new outer berth to create berthing facilities for renewable vessels and cruise ships.

24/7 Full-time engineering supervision of investigations over 4 months.

£1.5m Marine Ground Investigations

## Key services provided

Marine Geotechnical Engineering

Civil Engineering

24/7 full time engineering supervision (Client Representative)

Maritime Engineering

CDM services

Full time supervision of test excavation dredging

# Port of Leith, New Outer Berth for Marine Renewables



Installation of ADCP units



Transfer to Jack-up



Supervising Night Drilling Operations

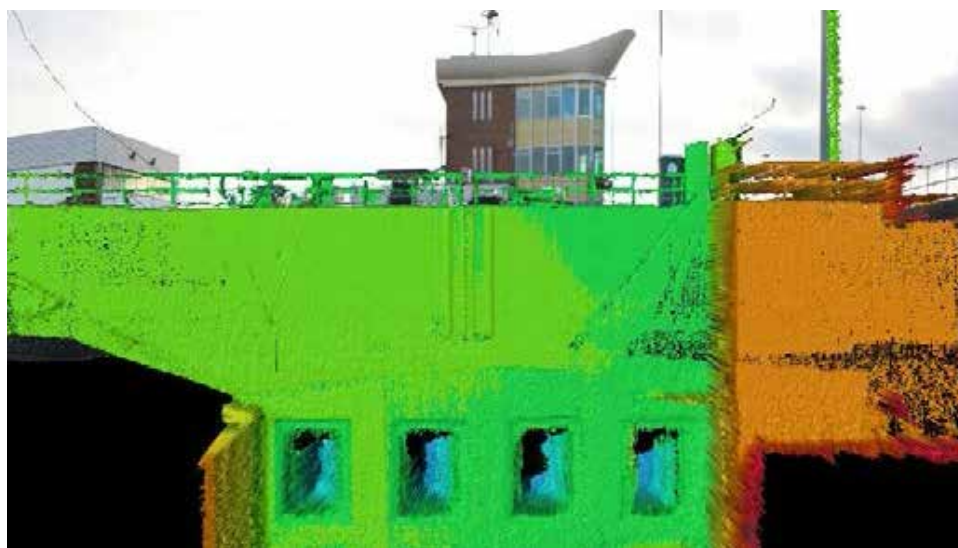


High Quality Cores for Logging and Testing

The investigations comprised forty five soil and rotary cored boreholes undertaken from a jack-up barge between November 2012 and February 2013. The boreholes were drilled using Geobor S coring methods to obtain the highest quality of geotechnical samples. Furthermore, eleven vibrocores samples were taken from the Middle Bank resource in the Forth area to identify if a suitable quantity of ‘high quality source’ material was present. The intention is for this material to be dredged and used to up-fill the site as part of the maritime construction. In addition, specialist waste acceptance samples were collected to determine where this material could be dredged and deposited in accordance with Marine Scotland guidelines.

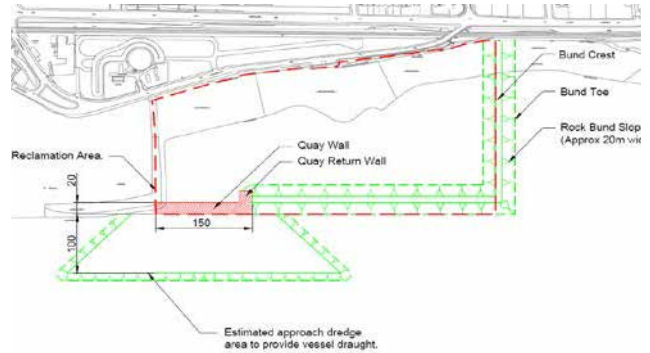
Arup provided full-time engineering supervision of the marine investigations and surveys which involved 24/7 supervision of the jack-up drilling operations between November and February. Our client representatives were present for all exploratory boreholes undertaken and ensured that the Eurocode 7 compliant drilling operations were undertaken in accordance with the contract specification. Our supervising engineers produced daily engineering reports and provided engineering assistance and guidance to the contractor to resolve technical difficulties quickly and provided immediate design team and client updates so that design options under consideration could be updated and refined, based on the findings from the investigations.

The scope of Arup service also included specifying and supervising high and low resolution Multibeam bathymetric surveys. The hi resolution surveys were required to assist in the assessment of the structural integrity of the existing eastern breakwater and jetty structures and the low resolution surveys were required to assist in the input to met ocean models to map the movement of sediment and also to assist in wave height modelling.



Hi-res multibeam survey of existing jetty structures © Fugro EMU

# Port of Dundee, Expansion to Facilitate Offshore Renewables



Port of Dundee Development Area

Arup specified, procured and managed marine site investigations to identify a source of suitable marine aggregate fill. This included all licencing and consent negotiations with SNH, Marine Scotland and The Crown Estate.

Arup created a preliminary design of the expansion options identifying possible reclamation layouts, including the following aspects;

- Expansion option appraisal
- Fill source identification
- Land reclamation arrangements
- Preliminary design constraints
- Construction options
- Reclamation methodology
- Construction budget costs
- Outline Construction Programme

## Client

Scottish Enterprise

## Key facts

Arup were commissioned by Scottish Enterprise for their Port of Dundee expansion project, which is proposed to assist the further development of the ports facilities in order to support the increased market demand for offshore renewables. This involved the development of design options to a feasibility stage, and management of a feasibility stage marine ground investigation of the expansion site and a potential marine aggregate source site.

## Key services provided

Marine Geotechnics

Full-time Engineering Supervision

Marine Ecology (inc provision of Marine Mammal Observer)

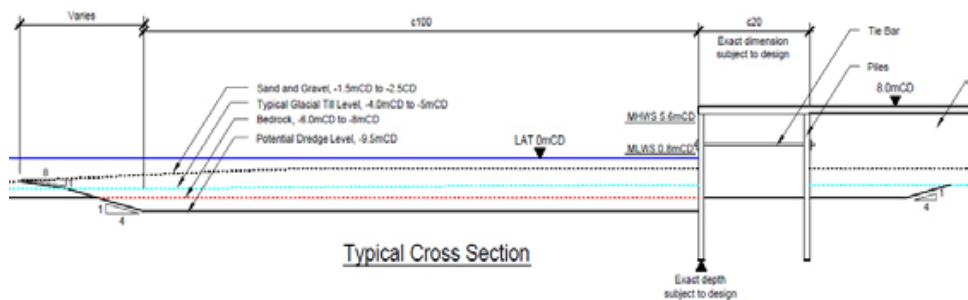
# Port of Dundee, Expansion to Facilitate Offshore Renewables



## Management of Feasibility Marine Site Investigations

Arup specified, procured managed the proposed Eurocode compliant marine site investigations for the purpose of identifying a suitable marine aggregate fill source for the land reclamation. Negotiations with the regulatory bodies including SNH, Marine Scotland and The Crown Estate in order to gain the required licences and consents formed a significant element of the project.

- **Procurement and contract management**
- **Eurocode compliant investigation**
- **Consenting processes** – early negotiations with Marine Scotland, SNH, The Crown Estate.
- **Supervision** – management of contractor works, monitoring of weather conditions, ensuring contractor had efficient works programmed.
- **Bathymetric surveys** – carried out to gain a seabed profile in intertidal, estuary & offshore conditions.
- **Marine mammal observer** – requirement of SNH for bathymetry survey. Arup coordinated this within our supervision role; ensuring procedures were in place and carried out & were coordinated with GI activities. A pragmatic approach ensured no delays were caused to the investigations.
- **Vibrocoring** – carried out for contamination & geotechnical analysis.
- **Grab sampling** – carried out for Benthic Analysis as part of EIA, seabed classification and contamination analysis.
- **Negotiation with Regulatory Bodies** – Experience on similar projects allowed Arup to open negotiations with Marine Scotland and The Crown Estate early in the process. This allowed a pragmatic approach to the potentially expensive contamination testing regime to be agreed and a significant cost saving was achieved.



# V&A Museum, Dundee



Artists Impression of the new V&A Museum, Dundee

Through efficient project management and full-time engineering supervision, Arup were able to manage and optimise the required scope of the works, resulting in a six figure cost saving to the client.

## Expert Geotechnical Advice

The clients requirements were for the investigations to be undertaken in accordance with Eurocode 7 and due to the experience of Arup on previous national and international marine ground investigation projects, Arup were able to advise on the most appropriate and effective drilling techniques to ensure the highest quality of samples were obtained for analysis and testing.

## Scope of Investigations

The investigations comprised nineteen soil and rotary marine boreholes from a jack-up in the River Tay, along with soil and rotary boreholes from a link-float pontoon system within Craig Harbour. In addition, vertical and horizontal rotary drilling and trial trenching to investigate existing dock walls was undertaken and marine bathymetric and geophysical surveying, current metering using ADCP equipment and marine benthic grab sampling was performed.

## Efficient Coordination of Land and Marine Investigations

The land and marine based elements of the investigations required significant coordination and management, which included significant liaison with users of the Olympia Sports Centre and Dundee Heritage Trust. Arup managed this process effectively to ensure that the full scope of investigation could be performed.

### Client

Dundee City Council

### Key facts

New Flagship Museum to be located on River Tay

### Key services provided

Marine Geotechnics

Civil & Structural Design

Mechanical & Electrical Engineering

Fire Engineering

Façade Design

Maritime Engineering

Full-time Engineering supervision

### Project Overview

Arup, as part of the Kengo Kuma / Cre8 Design Team were commissioned by Dundee City Council to first undertake a detailed geotechnical and geoenvironmental desk study of the site and then design, procure, and supervise intrusive land and marine based geotechnical and geoenvironmental investigations for the new V&A Museum that was to be constructed over the River Tay in Dundee. Arup subsequently produced a geotechnical and geoenvironmental interpretative report for the investigations.







## Curriculum Vitae

# Mike Collins

Mike is a chartered scientist and a geoscience specialist in the Arup Geotechnics group.

Having been involved in a variety of projects, both land and marine based, he has gained specialist knowledge in geotechnical subjects such as offshore drilling engineering and marine pile installation and underwater pile tension testing. Mike has also worked as an engineering geologist for a site investigation contractor and has developed a strong reputation for delivery and quality with both marine drilling contractors and clients.

**Profession**  
Geoscientist

**Current Position**  
Geoscientist

**Joined Arup**  
2006

**Years of experience**  
8

**Nationality**  
British

**Qualification**  
MSc St Andrews University  
BSc (Hons) Newcastle University

**Professional Associations**  
Chartered Scientist (CSci)  
Fellow of the Geological Society (FGS)

**Offshore Safety Training**  
Basic Sea Survival Certificate  
2004

Mike's experience in the supervision and quality control of ground investigations for marine projects has provided him with a full understanding of the principles of the marine ground investigation process.

## Marine Geotechnical Experience

### Port of Leith, Edinburgh – 2012 – 2013

Mike coordinated and led the Arup supervision team of marine ground investigations and surveys for the proposed new Outer Berth at the Eastern Breakwater at Port of Leith in Edinburgh. The investigations included soil and rotary boreholes from Fugro Seacore Aran 120a jack-up, vibrocore sampling, sediment grab sampling, ADCP current monitoring and hi and normal resolution bathymetric surveys. The investigations had a contract value of £1.3m.

### V&A Museum, Dundee – 2011 - 2012

Mike has designed and written the Marine and Land based ground investigation specification documentation for the proposed new V&A Museum in Dundee. Mike supervised the investigations on a full-time basis between January and April 2012, which involved the supervision of marine jack-up geotechnical drilling investigations, bathymetric and geophysical surveys, grab sampling, dock wall investigations and land based ground investigation. Mike was responsible for the completion and delivery of the geotechnical interpretative report which was submitted in July 2012. The ground investigation contract was also delivered £100,000 under budget through efficient project management.

### Femern Baelte 2009 – 2011 Offshore Investigations

Working as part of the Ramboll / Arup JV, Mike assisted with the supervision of the marine drilling, offshore piling and pile testing (Large Scale Testing) for the proposed new 20km bridge or tunnel between Denmark and Germany. This involved supervising geobor drilling and CPT's on Offshore Jack-up platforms (Fugro Deep Diver) and also supervising the offshore installation of bored cast in place and driven steel tube piles and their subsequent tension testing.



### **Femern Baelte Offshore Large Scale Testing Work**

During the 2010 and 2011 Femern baelte campaign, working in partnership with the Norwegian Geotechnical Institute (NGI) he also acted as site supervisor of the 20 million Euro budget large scale testing program within the Femern Baelte. This involved supervising the offshore installation of groups of driven and bored cast in place piles and the installation of extenso-piezometers within a 30m x 70m offshore test excavation to monitor heave and porewater pressures for the immersed tunnel option. As part of this role Mike supervised offshore underwater pile tension testing and had responsibility for the correct set up and test of the piles.



### **Forth Replacement Crossing, Firth of Forth, Edinburgh**

Both in 2008 and 2010 Mike was a member of the Jacobs Arup JV team that supervised the marine drilling investigations for the proposed Replacement Forth Crossing in Scotland. As part of the supervision team, Mikes role involved supervising the marine soil and rock drilling operations that were being undertaken by the drilling contractor and also the specialist in-situ geophysical and geotechnical testing that included High Pressure Dilatometer Testing (HPDT), Falling head tests, CPT's and down hole magnetometer surveying.

### **Additional Marine Ground Investigation – Seabed CPT's**

Mike was involved in the site supervision and quality control of vessel based marine cone penetration testing; undertaken within the Forth Estuary to determine alluvium strength profiles and thicknesses.



### **Marine Institute of Ireland / Geological Survey of Ireland / St Andrews University (MSc Thesis Project)**

Mike's Master's thesis at St Andrews University involved a marine geoscientific work placement for the Marine Institute of Ireland aboard the RV Celtic Explorer as part of the largest European Geological Mapping Exercise, the Irish National Seabed Survey (INSS). Mike's thesis project involved the analysis and interpretation of Conductivity Temperature and Density (CTD) measurements geophysical measurements and GIS mapping of the Rockall Trough, North-east Atlantic Ocean between the 2nd and 30th of July 2004. This was an offshore role that required him to work in a confined, offshore research vessel for 5 weeks.





## Curriculum Vitae

# John Brown

John is a Chartered Senior Engineering Geologist in the Arup Geotechnics group in Scotland.

Having over eleven years of experience as an Engineering Geologist both within contracting and consulting, John has contributed to a wide variety of environmental and geotechnical projects both on land and offshore. These projects have ranged from the construction of railways, highways, bridges, tunnels, dams, canals and flood defences, to dockland & brownfield redevelopment and the consolidation of former mine workings.

John's duties have ranged from the undertaking of preliminary feasibility studies for large infrastructure projects and the management of land and marine based ground investigations through to foundation design, project management and the supervision of offshore construction.

His experience has provided him with a firm grounding in the principles of engineering geology, geotechnical engineering and construction supervision on land as well as offshore through his involvement in schemes from both design and site based perspectives.

### Profession

Engineering Geologist

### Current Position

Senior Geologist

### Joined Arup

2008

### Nationality

British

### Qualification

BSc (Hons) Geology, University of Edinburgh

### Professional Associations

European Geologist (EurGol)

Chartered Geologist (CGeol)

Fellow of the Geological Society of London (FGS)

Treasurer (former Chair) of the Central Scotland Regional Group of the Geological Society

Member of the British Geotechnical Association (Affiliate Member of ICE)

Member of the Scottish Geotechnical Group

### Offshore Safety Training

Personal Survival Techniques  
STCW 95 Reg. VI/1 Section  
A-VI/1 Para. 2.1.1 – 2008

Basic Offshore Safety Induction  
& Emergency Training (Including  
HUET and EBS) – 2011

OGUK Offshore Medical  
Certificate - 2011

## Marine Geotechnical Experience

### Forth Replacement Crossing - 2011 to Current

Working as part of a site based Employer's Delivery Team (EDT) during the construction of this £1.6B project. John has been responsible for overseeing many of the early site works which included; the construction phase marine geophysical surveys and land and marine based ground investigations, the initiation of bi-annual bathymetric and flow surveys and continuous underwater noise monitoring. As construction works commenced John became responsible for overseeing all of the marine cofferdam and north land foundations on behalf of the EDT. In addition to overseeing these aspects of the permanent works John has been responsible for overseeing the development of port facilities and the projects marine logistics. The marine construction works have involved underwater excavations by rock blasting as well as dredging, piling, marine cofferdam construction by driven sheet pile, prefabricated and modular installation methods, underwater rock anchors, groundwater lowering of bedrock strata and underwater formation inspections.



### **Fehmarn Fixed Link - 2010 to 2011**

This major European project to connect Germany and Denmark, has provided John with valuable experience in the supervision of offshore ground investigation and marine construction.

Working as part of a Ramboll Arup JV, John assisted with the supervision of the 2010 marine boring campaign and the €20M 2010-2011 large scale geotechnical testing works for the proposed new 19km bridge or tunnel. This involved supervising geobor drilling and CPT's from Offshore Jack-up platforms (to define the site wide ground conditions), supervising the offshore installation and testing of groups of driven and bored cast in place piles (for the bridge option) and the construction a 30m x 70m offshore test excavation with the installation of extenso-piezometers to monitor heave and porewater pressures (for the immersed tunnel option).



### **Forth Replacement Crossing – 2008 to 2011**

Working as part of a Jacobs Arup JV this 2.63km multi-span cable stayed bridge project has offered John a broad range of technical experience in the procurement and supervision of three phases of marine ground investigation with a combined value of over £5M. Subsequently John worked within a large multi-disciplinary team and assisted in the development of the Specimen Design of the main crossing. In addition to being involved in the design of the bridge foundations, he was principally responsible for developing the geological ground model for the entire main crossing site.

### **Forth Replacement Crossing Study – 2006 to 2008**

Working as part of a multi-disciplinary team John's involvement in the early stages of this project gave him experience in the management of desk based studies and preliminary ground investigations for large scale infrastructure projects. The significant scale of this projects meant that these preliminary studies covered the entire greater Forth area. John's impute allowed initial decisions on crossing option and route selection to be made.





## Curriculum Vitae

# Duncan Johnston

Duncan is a Chartered geotechnical engineer in the Arup Geotechnics group in Scotland.

Having been involved in a variety of marine based projects he has gained specialist knowledge in geotechnical subjects such as deep and shallow foundations, earth retaining structures, earth stabilisation, slope stability and soil behaviour.

### Profession

Geotechnical Engineer

### Current Position

Engineer

### Joined Arup

2006

### Nationality

British

### Qualification

MEng Civil Engineering with International Studies, Heriot-Watt University, 2006. (First Class Honours)

### Professional Associations

Member of the UK Institution of Civil Engineers

UK Register of Ground Engineering Professionals, 'Professional' grade.

### Offshore Safety Training

Personal Survival Techniques STCW 95 Reg. VI/1 Section A-VI/1 Para. 2.1.1 – 2009

Basic Offshore Safety Induction & Emergency Training (Including HUET and EBS) – 2011

OGUK Offshore Medical Certificate - 2011

His experience has provided him with a firm grounding in the principles of geotechnical engineering through his involvement in schemes from both design and site based perspectives.

## Marine Geotechnical Experience

### Forth Replacement Crossing, Edinburgh

Involved in the planning, management and site supervision of a series of land and marine based ground investigations to facilitate foundation design of a 2.63km cable stayed bridge. Ground Investigations supervised included:

- Detailed South of Estuary Land Ground Investigation (£900k)
- Detailed Marine Ground Investigation (£2.1million)
- Additional Marine Ground Investigation (£250k)
- Dialogue Period Marine Ground Investigation (£2.0million)

Responsible for scheduling conventional and advanced geotechnical laboratory testing, scheduling in-situ testing and implanting the Contract and Specification.

### Forth Replacement Crossing, Edinburgh

Worked within a large multi-disciplinary team and assisted in the development of the Specimen Design of the main crossing. In addition to being involved design of the bridge foundations, he was responsible for the interpretation of geotechnical parameters of the sub-sea soil and rock.

These specific marine skills allowed him to be effective in the construction of the marine caisson and cofferdam foundations; whereby assisting the contractor and implementing the contract.



### **Fehmarnbelt Fixed Link, Germany and Denmark**

Responsible for the interpretation of advanced geotechnical testing of glacial soils, to facilitate the design of a 19km crossing linking Germany and Denmark. Derived geotechnical properties and produced the geotechnical design report for glacial soils.

### **Western Harbour Development, Edinburgh**

Design engineer for a land reclamation scheme within Leith Docks in Edinburgh; to create fully serviced plots suitable for residential and leisure development. He was responsible for the development of ground improvement strategies, which included surcharging and band drains, and designed a strategy to allow construction over a lagoon of soft silt.

He designed and specified investigation and monitoring procedures to allow verification of these strategies and to ensure that design performance had been achieved.



### **Western Harbour Quay Edge, Leith Docks, Edinburgh**

Completion of a feasibility study for a 790m quay edge to retain reclaimed land as part of the Western Harbour development. Following this work, he subsequently produced outline designs for a revetment structure and a sheet pile wall.

### **Port of Leith, Outer Berth, Edinburgh**

Site supervisor for a major marine ground investigation; undertaken by drilling rigs on jack-up barges. This investigation was required to assess the ground conditions for the design of a new outer berth at Leith Docks.





## Curriculum Vitae

# Andrew Sorrie

Andrew is a Graduate Engineer who joined Geotechnics group within the Edinburgh office of Arup Scotland in September 2011, after graduating from the University of Dundee with a First Class MEng degree. Andrew has joined the Infrastructure team in Scotland.

Prior to joining Arup, Andrew has also worked for an engineering consultancy in Brazil as a student, involving highways, infrastructure, rail and quality control projects.

During his time at Arup he has gained experience both on-site, design and analysis work. He has been involved in a variety of geotechnical projects, gaining a range of project and site experience.

This has included specification, tender and supervision of site investigations, scheduling of geotechnical testing, preliminary design of port expansions, outline design of flood remediation schemes, Category 2 checking procedures, design of soil nailed slopes, specification of earthworks, shallow foundation design as well as piling design & creating contract documents. Further to this he has experience using a number of geotechnical computer software packages. Andrew is also the representative of the Edinburgh office for the Arup Geotechnical Skills Network.

### Profession

Geotechnical Engineer

### Current Position

Graduate Engineer

### Joined Arup

2011

### Nationality

British

### Qualification

First Class MEng (Hons),  
Civil Engineering Design &  
Management, University of  
Dundee, 2011

### Professional Associations

Graduate Member of Institution of  
Civil Engineers, UK

Member of the ICE Scottish  
Geotechnical Group

Andrew is a graduate engineer who is specialising in Geotechnics. He has gained experience in project design, intrusive site investigation and site supervision as well as use of geotechnical computer analysis packages.

## Marine Geotechnical Experience

### Port of Dundee: Marine Investigation Management & Full-Time Supervision

Andrew has been leading the marine site investigations for the Port of Dundee expansion project which is to facilitate increased marine renewable manufacture. This has included site investigation management (scoping, preparing contract documentation, tendering works and liaison with regulatory bodies), full time site supervision of the marine investigations (which included vibrocoring, sediment grab sampling and bathymetric surveys) in three different sites, two within the Tay Estuary and one at the mouth of the north sea.

Further to this, he carried out the preliminary design for the 30 acre port expansion scheme, and so has experience putting the output of the marine investigation into practice.





### **Port of Leith: Marine Investigation Full-Time Supervision**

Andrew was part of the full time geotechnical supervision team of a large marine site investigation in the Forth Estuary for the Port of Leith expansion project. This included supervision of 24hr operations which involved 49 No. marine boreholes, bathymetric surveying and vibrocoring.

Prior to these investigations, Andrew was been involved in scoping and contract management of the site investigation works on the existing breakwater of the port and land based site investigations as part of the larger port expansion infrastructure works. In addition to this, Andrew has been involved in the geotechnical aspects of the preliminary design for the port expansion options.

### **Water of Leith Flood Prevention Scheme: Site Investigation Part-Time Supervision**



Andrew was part of the team supervising the site investigation works over a 2 month period, to facilitate the design of a flood prevention scheme. This role involved direct supervision of cable percussive and rotary drilling works, whilst successfully ensuring careful planning of works was carried out by the contractor to ensure standing time was minimised, as continuity of work was an essential requirement from the client.

### **Royal Hospital for Sick Children, Flood Defence Remediation: Site Investigation Part-Time Supervision**

This project has involved leading the site supervision of a site investigation into the current flood defence scheme at the hospital, where Arup are performing a technical advisor role. This has involved monitoring contractor performance, interpretation of results, providing technical recommendations and proposals of further works. This project has also included the outline design of a flood defence remediation solution, including utilisation of geotechnical software packages.



### **V&A Museum: Marine Foundation Preliminary Design**

Andrew has been responsible for calculations for the preliminary design of large diameter rock-socketed piles over water, prior to and following the intrusive marine investigation. This was during the preliminary design stage and has been used to inform further stages of costing and structural design. Further to the marine investigations, Andrew has utilised this SI information throughout the further design stages to create more accurate detailed design foundation solutions.





# Key Contacts



**Alan Richmond**  
**Director**

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Alan is a senior chartered civil engineer with several years of experience in Geotechnics. He is a Director of Arup with technical and administrative responsibility for the Infrastructure business in Scotland.

Alan was Project Director for the Feasibility Studies for offshore wind farm manufacturing and marine load out facilities at Port of Dundee and Port of Leith for Forth Ports. He was also Project Director for the marine aggregate land reclamation at Western Harbour. He is currently responsible for a number of onshore wind foundation design projects across Scotland.



**Colin McCreath**  
**Associate**

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Colin is an Associate and business leader of the specialist Arup Geotechnics group in Scotland.

In addition Colin currently leads the geotechnical team in the Arup Edinburgh Office, serving both external and internal clients. He is responsible for the delivery, to time and budget, for all projects undertaken by the team.

Colin has been responsible for the management, design and site supervision of the geotechnical aspects of a wide variety of marine civil and structural projects.



**Mike Collins**  
**Geoscientist**

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Mike is a chartered geoscience specialist in the Arup Geotechnics group in Scotland.

Having been involved in and leading a variety of marine ground investigation projects both in the UK and Europe he has gained specialist knowledge in geotechnical subjects such as offshore drilling engineering and marine piling installation and underwater pile tension testing.

Mike has also worked as an engineering geologist for a site investigation contractor and has developed a strong reputation for delivery and quality with both marine drilling contractors and clients.

For further information  
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