Institution: University of Dundee

Unit of Assessment: UoA 14 Civil & Construction Engineering

a. Overview

The Unit is composed wholly of researchers from the Division of Civil Engineering at the University of Dundee (UoD). Its research is structured within the overlapping thematic groups *Environment* and *Infrastructure*. *Environment* consists primarily of Fluid Mechanics and Geotechnical Engineering sub-groups, both of which share research interests in fundamental environmental processes and anthropogenic effects upon the environment. *Infrastructure* includes the Concrete & Construction sub-group (within which is the Concrete Technology Research Unit (CTU)), representing research interests in constructional materials, structural engineering, sustainability, offshore geotechnical engineering, earthquake engineering and systems reliability.

b. Research strategy

Achievement of RAE 2008 strategic aims: A central RAE2008 strategic aim was to manage staff succession effectively and to enlarge and reinforce areas of established research strength through key academic appointments. This has been achieved through preferential investment by the University in a mix of 7 established and Early Career Researcher (ECR) staff appointments (**Anastasopoulos**, **Bengough**, **Chan** (ECR), **Chernin** (ECR), **Leung** (ECR), **Muir Wood**, **Park** (ECR)) in key Divisional strengths of environmental fluid mechanics, geotechnical engineering and concrete and construction. The RAE2008 aims to increase research income and focus on new Research Council and EU funding opportunities have been successful, as evidenced by, for example, the 7.4 % growth in annual research income per submitted FTE, the winning of EPSRC First Grant awards by all 3 (**Brennan**, **Brown**, **Knappett**) of the Unit's 2008 ECRs and the grant awards to **Dong** and **Davies**, **Davies** and **Bengough**, **Brennan**, **Brown** and **Knappett** from EPSRC *SuperGen*, NERC *Oceans 2025* and EU FP7 Calls, respectively. RAE2008 plans to increase inter-institutional research collaborations have been realised through joint publications and research grants with over 80 UK and overseas institutions since 2008. RAE2008 aims to increase cross-disciplinary research have been achieved by new collaborations established with geologists, oceanographers and chemists (see Section (e)); most significantly, collaborations between the geotechnical engineering sub-group and the root-soil interactions group at the James Hutton Institute (JHI) have been formalised with the joint (50:50) staff appointment of **Bengough**.

An important RAE 2008 objective was to expand research activity in soil/fluid interaction problems. **Dong**'s EPSRC grant on wave-induced liquefaction around breakwater heads and his newly-established collaboration with **Muir Wood** on modelling soil liquefaction and seabed scour illustrates the progress made in meeting this objective. Likewise, the RAE2008 aim to expand the CTU's research base by increased emphasis on cement science has been delivered by **Jones**, **McCarthy** & **Dyer**, with new, industrially-funded research projects on, for example, fly ash performance (UK Quality Ash Association), the use of lime and fly ash for soil stabilisation (Highways Agency *et al*) and innovative cement combinations for concrete performance (Mineral Products Association, OMYA *et al*). RAE2008 aims to attract Knowledge Transfer Partnerships (KTPs) have also been met, with 5 SME-supported projects (Tayside Contracts, D J Laing, David Ritchie Ltd, Ian Farmer Associates, Pelamis Wave Power Ltd) being awarded since 2008.

Future Strategic Aims: The vision of the Unit is to be recognised internationally as (i) a centre of research excellence and (ii) a provider of research outputs that generate significant societal benefits in environmental health, prosperity and sustainability. This vision underpins that of the University, whose 2013 transformational plan has the core purposes of promoting the sustainable use of global resources, shaping the future through innovative design and improving social, cultural and physical wellbeing. The transformational plan will determine investment in the immediate future, especially into Civil Engineering which is recognised by the university as a key player in the delivery of the first of these goals. The Unit's research strategy articulates closely, therefore, with the institutional plan, the aims of which overlap significantly with those defined by the EPSRC Challenge Themes of *Energy*, *Engineering*, *Global Uncertainties* and *Living with Environmental Change*. The strategy will be delivered by undertaking and disseminating internationally-leading research in each of the Unit's 3 sub-groups and interfacial areas and investing in the development of research and leadership skills in its ECRs. An increased emphasis will be placed on interdisciplinary and cross-disciplinary research; for example, in aquaculture, bio-geo-engineering

and offshore renewable energy. The Unit will be a key component of the Offshore Renewables Institute (ORI), formed in 2013 by the universities of Dundee and Aberdeen. The 2013 grant (£250k) to the CTU from the Technology Strategy Board to develop concrete elements for Pelamis Wave Power for low-cost, high-performance wave energy converters, together with current participation by the Unit in the SuperGen, MERMAID and GeoWAVE projects illustrates the research potential of the Unit in marine renewables research. Significantly, the University has already committed a substantial capital investment of over £1.2M into the Unit's *Wind & Marine Renewables Test Centre for Concrete Materials and Foundations* (see Section (d) below).

The Unit will focus on translating its research to the non-academic sector. It played a key role in the submission of bids to the Scottish Funding Council (SFC) for industry–led Innovation Centres in *Aquaculture*, *Construction* and *Sensors*; engagement with these Centres is a crucial component of the Unit's future strategy for (i) increasing the impact of its research and (ii) identifying long-term research directions that underpin future technologies. The application of CTU research expertise to address the timely technical challenges associated with new construction and/or decommissioning of nuclear power plants will be pursued, including applying systems reliability and risk analysis expertise brought by ECR **Chernin**. With the recent appointment of **Anastasopoulos**, there will be an expansion of earthquake engineering research with **Brennan** and **Knappett** and increased development by **Dong** of a new research direction, namely marine geo-hazards (debris flows, mud slides), to complement the tsunami-related research of ECRs **Chan** and **Park**. There will be increased research internationalisation by the Unit, particularly in SE Asia, where research collaborations enjoyed by **Dong** and **Leung** with Chinese and Hong Kong universities and **Park** with Inje University (Korea) will be strengthened and expanded. The growth of the CTU partnership with University of Kentucky and the development of the recently-established collaboration of **Park** with University of Rhode Island (URI) constitute the growth points in the expansion of joint research programmes with US institutions.

c. People, including:

(i) Staffing strategy and staff development: The Unit's staffing strategy is inseparable from its research strategy, namely (i) to recruit individuals with track records of excellence, achievement and potential as leading researchers, (ii) to appoint in coherent research areas of existing strength, critical mass and long term potential to underpin technologies of the future (particularly in cross-disciplinary areas defined by the EPSRC Challenge Themes), (iii) to maintain a balance between ECRs and established researchers and (iv) to foster the ambition of all staff by providing targeted resources, access to professional development and networking opportunities to enable them to become leaders in their field. Staff are sought with either laboratory-based or theoretical/computational expertise (or both), in order to exploit fully the considerable investment the Unit has made in purpose-built laboratory facilities and advanced research equipment (*e.g* the Geotechnical Centrifuge). The most recent staff (**Anastasopoulos**, **Chan**) were recruited through the *Dundee Fellows* programme, launched in 2013 to identify, via a worldwide search, researchers with outstanding track records of current and potential leadership in their field. **Anastasopoulos** brings complementary expertise in earthquake engineering to the geotechnical engineering sub-group, while **Chan**'s research specialism (coastal waves) complements the coastal engineering and tsunami dynamics expertise of ECR appointment **Park** and the environmental focus of the Fluid Mechanics sub-group. Structural engineering has been strengthened by ECR appointment **Chernin**, with his expertise in structures, risk analysis and numerical modelling of concrete behaviour. The appointments of **Muir Wood**, **Bengough** and **Leung** have enhanced the geotechnical engineering sub-group, leading to the establishment of new directions in geo-environmental and bio-engineering research.

Career Development: All staff (including Research Assistants) benefit from annual individual reviews of their research progress by their appropriate line manager, as part of the Objective-Setting & Review process that delivers the University's strategic aim of embedding and supporting a culture of performance management and improvement. All newly-appointed staff are guided by a mentor (a senior colleague) to help formulate and achieve personal performance goals and deliver the Unit's research objectives. They enjoy sheltered teaching, generous start-up funds and, in the case of ECRs, preferential allocations of PhD studentships to aid the rapid establishment of their research profile and incorporation into group activities. All staff are supported to disseminate

their research through publications, seminars and presentations to international scientific meetings. All grant proposals are required to be peer-reviewed in draft by established researchers within the School, prior to proposal submission. A thriving Divisional seminar programme ensures effective exposure of staff to national and international research developments.

The development of researchers, both postdoctoral researchers and early career academics, is integrated into the HR strategy, with training and development opportunities for all staff and postgraduate researchers provided centrally by the Organisational and Professional Development unit (OPD) formed in 2011 from the merger of *Generic Skills Dundee* (the training and development unit formed under the Roberts' agenda) with the previous staff development unit. OPD provides a programme of training and development opportunities for all staff and postgraduate researchers at the UoD. It plays a fundamental role in underpinning and supporting the University's desire for improved performance, clear pathways for career development, succession planning and enabling staff and postgraduate researchers to fulfil their full potential and to develop their careers and skills. The development programme is designed to support individuals, teams and the organisation and to increase efficiency, effectiveness and employability. University policies and processes demonstrate continued development of a working environment supporting research excellence and increasing focus and impact. UoD launched the *Concordat to Support the Career Development of Researchers* in 2009; the Unit is committed to its implementation and is engaged fully with the UoD Concordat Action Plan. Consultation with researchers about their awareness of the Concordat and the progress made is provided through representation on the Steering Group. Progress is evidenced by the recognition of the University by the European Commission for its 'HR excellence in research' – an accolade granted only to EU universities whose policies and processes demonstrate continued development of a working environment supporting research excellence and increasing focus and impact.

Personal Fellowships: Park held a 2 year Newton International Fellowship within the Fluid Mechanics sub-group prior to his appointment to a Lectureship in 2013, the same year in which he won a 5-year Royal Society of Edinburgh/Scottish Government Personal Fellowship co-funded by Marie Curie Actions. This award will allow him to spend 2014 -15 with Grilli at URI to develop a 3-D numerical tank for tsunami modelling, a collaboration established as a result of an SFC Postdoctoral & Early-Career Researchers Exchange grant he won in 2013.

International Staff Appointments: Of the 7 appointments made since 2008, 4 were recruited from overseas universities; **Chan** and **Park** joined from Cornell, **Anastasopoulos** from National Technical University of Athens (NTUA) and **Leung** from Hong Kong University of Science & Technology. Of outgoing staff, Jeng was appointed to a Full Professorship at Griffiths University in 2013 (but maintains his active research collaborations with the Unit as a partner in the *MERMAID* project) and Bransby took up a position with Applied Geotechnics, Perth (Australia) in 2010.

Visiting Scholars: Laanearu (Tallinn) held a Royal Academy of Engineering Distinguished Visiting Fellowship in **Davies**' lab in 2011 and Constantinescu (Iowa) and Liu (Cornell) were funded as Visiting Fellows on EPSRC grants held by **Davies** and **Dong** respectively. Wang (Ocean University of China) and Zhang (Hohai) were academic visitors sponsored by the Chinese Scholarship Council (CSC) and the CTU hosted stays by Al-Otaibi (Kuwait), Kara (Riga), Yu (Tianjin) and Sugiyama (Hokkai-Gakun, Japan). The Fluid Mechanics and Geotechnical Engineering sub-groups hosted Doherty (W. Australia), Kolymbas (Innsbruck), Herle (Dresden), Hilaire (ENS Cachan) and Rozas (Chile) for stays of 2-12 months. Li (Chinese Academy of Soil & Rock Mechanics), Chen (Beijing Jiaotaong), Kraus (Osijek), Loli (NTUA) visited to utilise the Centrifuge.

Equality & Diversity: The Unit is committed to maintaining an inclusive culture and collegiate working practices. All staff undertake training on equality and diversity, delivered from the online training modules *Diversity in the Workplace*, *Disability*, *Stress in the Workplace* and *A Manager's Guide to Stress*. A further module on *Recruitment and Selection* is taken by affected staff. Completion of the training programme is monitored centrally and the importance of the action is emphasised to staff by all levels of senior management within the Unit.

(ii) Research students

Recruitment: The Unit advertises nationally and internationally to attract the best PhD candidates, most of whom are supported by the EPSRC Doctoral Training Grant (DTG). Supervisors contribute 50% of the cost of each studentship from external funds (a condition relaxed for ECR staff) to maximise PhD numbers. The Northern Research Partnership (NRP) and the Energy Technology Partnership (ETP) – both established in 2008 with SFC funding as regional- and discipline-based research poolings - also serve as sources of PhD studentships. Since 2008, the Unit has attracted 6 studentships from the NRP for projects supervised jointly by Dundee and Aberdeen universities. Matched funding for 4 PhDs has been won from the ETP and additional joint funding of studentships has been won from the BBSRC and James Hutton Institute (JHI). The Unit invests substantial effort in attracting overseas PhD students through extensive recruiting visits and the fostering of close research collaborations. Post-2008, emphasis has been placed on visits to leading Chinese universities, implementing formal collaborative agreements between the University and its Chinese university partners and establishing partnerships with the CSC. This has generated 8 funded PhD studentships from this source in geomorphology, fluid mechanics, geotechnical engineering and concrete technology; growth in support from this source is expected. The Unit has also attracted increasing numbers of high-calibre PhD students supported by the Ministry of Higher Education & Scientific Research, Iraq, particularly in geotechnical engineering.

Training & Support: All PGRs take the Unit's course in *Research Methods* and attend a compulsory induction course on *Health & Safety*. Their supervision is governed by the University Code of Practice for Supervised Postgraduate Research, the maintenance and monitoring of which is the responsibility of the Postgraduate Research Sub-Committee, the university body concerned with quality assurance of all its research degree programmes. PGRs attend a Postgraduate Induction Course at which they are briefed fully on the bespoke training opportunities for PGRs provided by the University OPD programmes. Funding is provided to each student to enable him/her to present thesis work at an international conference.

Progress Monitoring: Each student has at least 2 supervisors, accountable to the Dean for the satisfactory progress of the PhD project. The Thesis Monitoring Committee (TMC), meeting twice per year, provides independent assessment of a PGR's progress and an independent forum to resolve difficulties in student-supervisor relationships. The reports of the TMCs play a crucial role in determining any individual student's readiness for transfer of ordinance to PhD. Each School has a Postgraduate Student Adviser to whom PGRs have access. All PhD students are required to present their work in the Unit's seminar programmes, as part of the transfer of ordinance.

d. Income, infrastructure and facilities

Specialist Infrastructure: The key elements of infrastructure are the advanced laboratory facilities (both equipment and instrumentation) in the Geotechnical Engineering and Fluid Mechanics sub-groups and the CTU. The Dundee Geotechnical Centrifuge has been fully re-fitted since 2010 and equipped with an earthquake simulator, unique in the UK for being operational with realistic earthquake excitation, all funded (£0.5M) by NRP. These enhancements, together with a fault actuator unique in Europe and a climate chamber facility to simulate environmental loadings have led directly to the award of 2 EPSRC first grants (**Knappett**, **Brennan**), the attraction to Dundee of a distinguished earthquake engineering researcher (**Anastasopoulos**), the award of the FP7 *GeoWAVE* grant (**Knappett**, **Brown**) and utilisation of the facility by partners in China, Croatia, Greece and New Zealand. It is a vital research tool for the newly-established ORI and is the first facility for geotechnical testing included within the (Scottish Enterprise) Scottish Energy Laboratory. It is supported by a suite of specialist laboratory equipment for undertaking soil element tests, including a unique triaxial test apparatus for ultra-high speed testing associated with dynamic geotechnical processes, also funded by EPSRC. The centrifuge has been the principal factor in winning £877k from public and private sector project funding and service contract work since 2008.

The Fluid Mechanics laboratory has 3 purpose-built flumes constructed with EPSRC grant support for studying environmental flows, including a 10 m re-circulating channel for deep turbulent cross flows and a 12 m internal wave channel for internal solitary wave and wave-induced sediment transport studies. Its flow measurement equipment, all funded by EPSRC/NERC grants, includes (i) 3D PIV/LDA systems, (ii) 4 *DigiFlow* systems and (iii) advanced micro-conductivity sensor

systems for stratified turbulence studies. The CTU has invested heavily in specialised material characterisation equipment (XRD, XRF, thermo-gravimetric analysis, laser particle size analysis, mercury intrusion porosimetry, nitrogen adsorption) and plans future acquisition of X-ray micro CT and advanced rheometry equipment to support its research and consultancy.

Future infrastructure investment will establish the *Wind & Marine Renewables Test Centre for Concrete Materials and Foundations* as the leading facility for the development, design and testing of marine renewable construction materials and prototype foundations. The Centre will combine the existing academic strengths and industrial experience of the CTU and the Geotechnical Engineering sub-groups. It will support the ORI and become an integral part of the Scottish Energy Laboratory network (in which the Geotechnical Centrifuge is already included), offering industry, client bodies and regulators advanced test facilities and enabling whole life performance and cost assessments for high-repeatability production to be undertaken. The Centre has already attracted an ERDF grant of £833k to **Jones** (though announced since the end of the assessment period), with matching UoD investment of *ca* £1.1M, The second focus of infrastructure enhancement, namely the new tsunami modelling facility funded by **Park**'s recent Personal Fellowship award, will develop a novel laboratory tsunami generator to simulate observed wave characteristics much more accurately than current laboratory devices. Such a modelling facility is much needed internationally, in view of urgent current concerns over consequences of rock collapse- and earthquake-initiated tsunamis in reservoirs, fjords and coastal waters.

Research Funding: The Unit has attracted over £4M in research income since 2008, with grants from UK research councils (EPSRC, NERC, BBSRC, MRC), industry and the EU, supplemented by (i) sponsored studentships from the sources outlined previously and (industrially-commissioned research. All of its RAE2008 ECRs have won EPSRC First Grants. Total annual research income per FTE, excluding PhD studentship awards, has increased by 7.4% compared with the previous assessment period. Significant awards have been won by the CTU from non-departmental public bodies in the UK and overseas; grants totalling £300k in partnership with industry and the government-funded Waste Resources Action Plan (WRAP) have led the development of recycled aggregates in concrete and low embodied CO2. This has underpinned joint projects with Aberdeen and Kentucky on application of novel energy cements in shock-damaged structures and silt-sized wastes, funded by NRP and the US Institute for Homeland Security (£135k). This led to the 2013 award to **Jones** of a £700k project to develop 'green concrete' materials and national standards for Qatar, funded by the Gulf Organisation for Research & Development.

Future Plans: The Unit will exploit its critical mass in its specialist areas to seek platform grant funding. It plans to increase its research income by 30% by 2018 and to increase its PhD population by 20% by (i) attracting increased DTG support, (ii) increasing focus on EU funding opportunities and (iii) nurturing partnerships already established with overseas universities. It will target EU Horizon 2020 opportunities to exploit the track records of the Unit in geotechnical and earthquake engineering, cementitious materials, offshore energy, aquaculture and bio-geo-engineering; utilisation of these funding opportunities is a key component of the Unit's strategic plan. Exploitation of funding opportunities associated with the newly-established Scottish and TSB Innovation Centres and the UoD ORI will be crucial. Staff will pursue external personal Fellowship awards as a high priority, to facilitate additional targeted investment in research strengths.

Consultancy: The Unit undertakes extensive consultancy work to translate its research expertise and facilities to practice. The CTU's specialised material characterisation equipment has been used for material supplier Lafarge/ScotAsh and its extensive chemical and strength testing facilities have been utilised for Forth Crossing Bridge Constructors, Atkins UK, RSK Environmental Consulting, Stirling Precast Ltd, Highways Agency, Specialist Contracting Ltd and ScotAsh Longannet's Biomass Project. **Dong** and **Davies** have undertaken hydrodynamic modelling for the *V&A at Dundee* construction project of the Dundee Waterfront Regeneration Scheme and **Brennan** and **Brown** utilised physical modelling to provide data on sea floor pipeline stability for offshore support companies Technip, Acergy, Pegasus and Subsea 7. **Vardy**'s consultancy activities have been undertaken primarily through the licensing of his rail tunnel simulation programs *ThermoTun* and *MPVC* for use by major engineering consultancies (*e.g* Arup, HBI

Haerter, RSSB, NEXCO) in the design and operation of underground railways, high-speed inter-city railways and road tunnels worldwide. **Vardy**'s consultancy with Paradigm Flow Solutions has applied his software *PipePulse* to detect and locate blockages in oil pipelines; this has been recognised by the company as saving its client £4M in intervention costs (see Case Study).

e. Collaboration or contribution to the discipline or research base

Research Collaborations: Exemplars of successful international collaborations are the FP7-funded projects *GeoWAVE* (led by **Knappett**, with naval architects and coastal engineers at UC, Cork), *MERMAID* (**Brennan** with a consortium of 11 Universities, 8 Research Institutes, 5 Industrial partners, 4 SMEs), investigating innovative, multi-purpose offshore platforms and *PERPETUATE*, *DARE* and *SERIES* (**Anastasopoulos**), all multi-institutional projects concerned with seismic engineering and earthquake protection. **Brennan** collaborates with Universidad Catolica de la Santisima Concepcion, Chile on field measurements of structural settlements after the 2010 Maule earthquake and Keller Holdings, Germany on the utilisation of stone columns for liquefaction mitigation. Since 2011, **Dong** has collaborated with the Ocean University of China in an NSFC-funded project to study transport processes of large scale mud deposits in the Yellow Sea. UoD has supported **Dong** to undertake biannual, locally-funded visits to China; additional support obtained from both CSC and UoD has funded a PhD student at Dundee. Further inter-HEI research collaborations have been established with EPSRC and NERC grants won by (i) **Dong** & **Davies** (with Hull, Strathclyde, National Oceanography Centre (NOC) for marine turbine-generated sediment transport), (ii) **Vardy** (with Sheffield and Brinker Technology) for unsteady turbulence and transient friction in pipes, (iii) **Davies** (with Bristol, Aberdeen) for coastal brine discharge modelling and (iv) **Davies** (with Plymouth and SAMS) for ocean outflow studies. The National Telford Institute (the SFC-funded civil engineering research pooling) has facilitated the Unit's growth in joint research with Scottish universities and other SFC research poolings (*e.g* the ETP).

Interdisciplinary Research: Collaboration between the Geotechnical Engineering sub-group and JHI, together with the award of the multinational FP7 *EURoot* project (**Bengough**), has led to 7 externally-funded, interdisciplinary PhD studentships in root-soil interactions. Related research with Montpellier now links to UK Forestry policy on slope stabilisation (**Bengough**, **Knappett**), via collaboration with (and PhD sponsorship by) Forest Research. MRC discipline hopping awards to **Bengough** and **Knappett** to investigate soil penetration by plant roots led to Norwegian Research Council- and BBSRC-funded collaborative projects with Oslo and Cambridge and JHI respectively. Related grants have been awarded by the National Grid (**Bengough**, **Brown**, **Brennan**) to investigate environmental effects of hot underground bodies crossing agricultural and forested land and MRC/EPSRC/BBSRC (**Bengough**, **Knappett**) for new geotechnical approaches to soil biological processes. **Dong** has jointly-funded collaborations with geo-morphologists (East China Normal University) and marine geologists (Ocean University of China) and interdisciplinary collaboration underpins (i) **Brennan**'s collaboration with Aberdeen (Geography) applying geotechnical modelling techniques to degradation of glacial ice sheets and (ii) **Park**'s work with marine geologists (Lisbon, BGS) on tsunamis. **McCarthy** collaborated with Geology/Mining Engineering colleagues at Kentucky on a DEFRA-funded research project on fly ash processing and **Dyer** is funded by AHRC and Historic Scotland to investigate historic concrete structures.

Collaboration with Research Users: A notable example of research collaborations with industrial end-users informing research strategy is provided by **Vardy**'s participation in the design of many of the world's longest road and rail tunnels. The particular need from industry for guidance on whether tunnels will emit sonic booms into the surrounding atmosphere has stimulated new research by **Vardy** on the evolving shapes of propagating wavefronts and the associated modelling of 3D unsteady skin friction on pipe/tunnel walls. **Vardy**'s 2010 EPSRC grant with Aberdeen and Sheffield, investigating the characteristics of turbulence in non-equilibrium flows, has provided detailed understanding of wave/boundary-layer interactions and directional redistributions of turbulence to allow the development of generic methods of modelling rapidly-varying wall shear stresses in highly unsteady flows for application to tunnel problems. Likewise, **Dong**'s funded collaboration with Angus Council to identify the causes of erosion at Montrose Bay has led subsequently to new research on the effects of anthropogenic factors on coastal evolution in the UK and China. Roger Bullivant Ltd's sponsorship of **Brown**'s CASE studentship on continuous helical displacement piles has led to (i) part sponsorship of a further PhD studentship on piles in

over-consolidated soils and (ii) a PhD studentship, sponsored by the Iraq government, on innovative foundations for deep-water wind farm installations. ETP-funded studentships to support collaborations with industry have been obtained by **Brown**, **Brennan** and **Leung**, on, respectively, foundations for marine energy generators, critical SG for cables during backfilling and installation processes and the use of geothermal piles as heat storage devices for enhanced embankment performance, part-funded by Lloyd's Register, Subsea 7 and Transport Scotland. The Unit's geotechnical research related to the marine renewables sector has generated substantial collaborative work with industry (Subsea 7, CTC Marine/DeepOcean, Technip, Cathie Associates) since 2008, leading to co-funding of a DTG studentship and 2 research contracts.

Leadership in the Academic Community: Davies serves on the UK Panel of Theoretical & Applied Mechanics, the Scottish Government ministerial sub-groups *Containment in Aquaculture* and *Sustainable Aquaculture: Science & Research* and the International Advisory Board of the EU *HYTECH* project. He is Chair of the Independent Advisory Board for the EU *HYDRALAB IV* Programme and Director of The National Telford Institute. He was a Member of the Review Committee (2008) for the School of Environmental Systems Engineering, U. Western Australia. He served as Director of the NRP and Board Director for the National Subsea Research Institute between 2010 and 2013. Since 2008, **Muir Wood**, **Davies**, **Jones**, **Dong** have served as EPSRC College members and **Muir Wood** sat on the panel assessing the quality of research output of Italian universities, the Prize Fellowships Panel of the Leverhulme Trust and the Fellowships Panel of the Royal Society of Edinburgh. **Brown** chairs the ICE Scottish Geotechnical Group, **Dyer** was a member of the 2012 UK Oil and Gas Working Group on decommissioning of offshore oil rigs and **Jones** was appointed in 2013 to the Scientific Committee of the *SuperGen* Hydrogen Hub.

Muir Wood and **Vardy** are Fellows of the Royal Academy of Engineering, **Davies**, **Vardy** and **Muir Wood** are Fellows of The Royal Society of Edinburgh and **Davies** is an elected Foreign Member of the Norwegian Academy of Science & Letters (2010). **Davies** was awarded the 2013 Royal Society of Edinburgh Lord Kelvin Medal and **Anastasopoulos** the 2012 Shamsher Prakash research award and the 2012 ISSMGE Young Researcher Award in Earthquake Geotechnical Engineering. Outstanding research publications were recognised by the 2009 ICE Telford Gold Medal (**Vardy**), 2009 ASCE Karl Emil Hilgard award (**Davies**), 2009 ICE/Society for Earthquake & Civil Engineering Dynamics T K Hsieh Award (Knappett), 2009 British Geotechnical Association Medal (**Knappett**) and 2012 ICE *Magazine of Concrete Research* best paper award (**Jones**).

Keynote Lectures have been presented by **Davies** (*3rd Int'l Symposium on Shallow Flows*, Iowa, 2012), **Anastasopoulos** (*7th Int'l Conference on Case Histories in Geotechnical Engineering*, Chicago, 2013; *2nd Int'l Conference on Performance-Based Design in Earthquake Geotechnical Engineering*, Taormina, 2012), **Bengough** (*3rd Int'l Symposium on the Use of Vegetation for Slope Stabilisation*, Vancouver, 2012), **Dyer** (*Statoil R&D Summit*, Trondheim, 2011), **McCarthy** (*EuroCoalAsh Conference*, Thessaloniki, 2012), **Brown** (Japanese Geotechnical Society, Tokyo, 2010), **Knappett** (*7th Int'l Conference on Offshore Site Investigation & Geotechnics*, London, 2012), **Muir Wood** (*4th Int'l Symposium on Deformation Characteristics of Geomaterials*, Atlanta, 2008; Poulos lecture, Australian Geomechanics Society, 2010; *19th Prague Geotechnical Lecture*, 2011; *7th Portuguese Geotechnical Congress*, Lisbon, 2012; ASCE Engineering Mechanics Institute Conference Northwestern University, 2013).

Editorships are held by **Brown** (ICE *Geotechnical Engineering*), **Davies** (ICE *Engineering & Computational Mechanics*) and **Muir Wood** (*Int'l J. Physical Modelling in Geotechnics*). **Davies** and **Muir Wood** serve as Associate Editors of *Environmental Fluid Mechanics* and the *Canadian Geotechnical Journal* respectively and Editorial Board members since 2008 are **Anastasopoulos** (*Geotechnical Engineering*), **Knappett** (*Géotechnique*), **Brennan** (*Géotechnique*, *Int'l J. Geotechnical Earthquake Engineering*), **Muir Wood** (*Int'l J. Numerical & Analytical Methods in Geomechanics*, *J. Earthquake Engineering*) and **Jones** (*Int'l J. Sustainable Built Environment*, *Coal Combustion & Gasification Products*). **Davies** is the IAHR Monograph Series Editor and **Brown** is General Editor of the ICE Manual of Geotechnical Engineering.