

Institution: University of Bath

Unit of Assessment: 16: Architecture, Built Environment and Planning

a. Context

The Department of Architecture & Civil Engineering (ACE), which comprises this UoA, undertakes internationally recognised research that tackles practical problems vital to society's long-term well-being. These problems include carbon emissions from buildings, building environmental performance, prolonging life of historic and engineering structures, and the sustainable use of building materials. Our impact agenda is promoted within the context of our three research centres (Building Research Establishment (BRE) sponsored Centre for Innovative Construction Materials (CICM), Centre for Advanced Studies in Architecture (CASA) and the Energy & the Design of Environments (EDEn)), as well as through teaching (via industrial placements and involvement with final year projects, and PG distance learning). Each centre has an 'Impact Champion' (Hart in CASA, Walker in CICM, and Coley in EDEn). The non-academic audiences for our research are the construction industry and professions, and include the general public (especially within CASA). The Department has an industrial board of advisors, with leading figures such as Mike Otlet (Atkins) and Sam Stacey (Skanska). The range of international beneficiaries of our research is wide. Our work with the construction industry involves well over 20 partners including ARUP, Atkins, Buro Happold, CINTEC, Expedition Engineering, Hanson, Ibstock, IED, Kier, Lhoist, Lime Technology Limited, ModCell, Oakwrights, Ramboll, Wates, and White Design. We also work closely with professional bodies to promote building engineering physics for sustainable design. These bodies include the Institution of Structural Engineers, the Royal Academy of Engineering (RAE, witness Visiting Professor Doug King's reports on sustainability and centres of excellence in 2009 and 2012), the Chartered Institute of Building Services Engineers (CIBSE), and the Institution of Civil Engineers (ICE). And we work with exhibition venues and the media in seeking the widest possible public engagement with our research in the UK and abroad.

b. Approach to impact

A concern for impact lies at the heart of our research activity. To ensure that our research has maximum practical impact on society's long term well-being we use a **multi-stranded approach** including: industrial collaborators as Visiting Fellows, secondments, Industry funded research students, consultancy projects, industry seminars, interaction with policy makers and Knowledge Exchange (KE) projects. Research impact, KE activity and public engagement are all important aspects of **staff appraisal** and confirmation of appointment. These activities are recognised in the Department's Workload Model. Impact plans are reviewed by the KE champion and the Director of Research (Hart, who has also sat on the University's Impact Group). We encourage impact through the mentoring of ECRs. Within the CICM there is emphasis on developing research leadership in an industrial context, and the publication in professional journals. The Department has a policy to interact with non-academic users through hosting visitors and industrial secondments: it hosts **Visiting Professors** and **Fellows** from our industrial collaborators, for example: Steve Denton (Parsons Brinckerhoff), Pete Bonfield (BRE), Robert Aish (Autodesk), Tim Yates (BRE), Ian Pritchett (Lime Technology), Sam Stacey (Skanska), Tim Mander (Integral Engineering Design), King (RAE VP) and Julie Bregulla (BRE). In 2012, *Building Design's* 'Top 50 Green Leaders' included our VPs Fordham, King, Clegg and Gething. We host the annual Sir Edmund Happold Senior Visiting Fellowship, open to consulting engineers (Dr Paul Jacquin from Ramboll in 2009). We also collaborate with alumni in prominent positions within the construction industry, for example Andrew Wylie from Buro Happold (EngD project) and Pete Bonfield (BRE).

The Department hosts **secondments** from industry, principally within the CICM: for example Andy Sutton from the BRE to work on a KE project (2010-2011); Giles Mortimer from the Integral Engineering Design to work on the EUROCELL project (2011); and Max Burbridge from Lime Technology to work on a joint Higher Education Innovation Fund and Lime Technology funded project to develop hemp-lime panel construction (in 2012). The Department also hosts a number of construction industry-funded post-graduate **research students**: collaborators include the BRE Trust (9 students), Great Western Research in partnership with Ibstock and the Silvanus Trust (2 students), Network Rail (50% funding with the university, 1 student), Lhoist R&D (50% funding with

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the university, 1 student) and Atelier One (20% support from the University, 1 student). Additionally, EPSRC Case Awards have been held by students working with: Lime Technology, ARUP, Atkins, MBE KTN, and the BRE. Industry partners on EngD programmes (4 students) include the National Trust, Buro Happold, Ramboll, and Expedition Engineering.

The Department also encourages staff to work in **consultancy** to industry. This work applies our research expertise, and builds links with industry (for future Technology Strategy Board (TSB) grants and KTPs); a number of projects, including the ModCell/BaleHaus work (see the 'BaleHaus' case study), started as consultancy. Consultancy projects include work for Buro Happold on rammed earth and hemp-lime, Deloitte on low impact materials, and European Lime Association on mortar yields. The Department encourages **research collaborations** with the construction industry: eg the ongoing BaleHaus project supported by the TSB with White Design, IED, Lime Technology, ModCell, Eurban, and Wilmott Dixon; the project received 50% industry funding, amounting to £350k. The HemPod project was supported by DEFRA, Lhoist UK, Lime Technology, WATES, Hanson, Feilden Clegg Bradley, and Hemp Technology; this project received 50% industry funding of £410k. The EUROCELL project was supported by White Design, ModCell, and BB-Architekten, and received 50% match funding amounting to €800k. In 2011/12 the Department hosted the EPSRC-supported Low Impact Materials and Innovative Engineering Solutions Research Network (LimesNet). This aimed to connect staff with the construction industry to develop a shared agenda in the field of ground and structural engineering; it had over 240 members, including over 100 from industrial partners (notably ARUP, Carillion, Ramboll, Buro Happold, Atkins, and Network Rail); it received in-kind support from industry of £220k. LimesNet awarded over £100k to its members to help build sustainable research partnerships.

The Department hosts a number of **seminars series** aimed at industry, such as the LimesNet workshops (2011-12), a BRE series of CPD presentations promoting low impact construction (over 400 attended, winning a prize from the Chartered Institute of Building), and CPD courses on EuroCodes for structural engineers. Workshops on renewable materials were held at Ecobuild in 2010 and 2012. We also hosted invited public lectures from prominent industry figures, notably Keith Clarke (former CEO of Atkins) in 2011. Conferences hosted by CICM such as NOCMAT 2009 and Fabric Formwork Concrete 2012, included industry delegates. In 2013 Coley secured £5k from the EPSRC Impact Acceleration Account to hold an industry reception as part of FutureBuild 2013. The Department seeks to promote the widest possible **public engagement** with our research, through international exhibitions, lectures and the popular media (see the 'Public Understanding' case study). The BaleHaus was part of 'Bath Green Homes' weekend in 2011, visited by over 100 members of the public. In addition, with funding from the EPSRC of £40k, Shepherd has lectured to schoolchildren (13,000-date) on research into Olympic stadiums. Staff have entered the University's annual 'Images of Research' exhibition, on public display in Bath and local schools. Staff are actively engaged with **policy makers**: Harris sits on the BSI Technical Committee; Walker and Lawrence are members of RILEM International Technical Committee; Hammond has advised Ofgen (2010) and the Dep. of Energy & Climate Change (2011); and Darby authored TR55 (see 'Concrete Infrastructure' case study). Hammond's *Inventory of Carbon and Energy* (ICE: BSRIA 2011) in materials database supports 15,000 users worldwide.

The Department has hosted a number of **KTP and KTA projects** during the assessment period, with a total value of £85k. McCombie received £25k (and £50k in kind) to develop a proposal with the Royal Academy of Engineering for a Centre of Excellence in Building Engineering Physics; and Walker received £57k to support an incoming Fellowship from BRE. We have collaborated on KTP projects with Cintec, Rotafix and Kingeree (total value of £330k). More generally, Walker serves as the Department's KE champion. He has support funding of around £10k: £3.5k was given to a LimesNet workshop (July 2012), with 39 industry attendees including SMEs; and £10k was given towards the relocation of the BaleHaus to a more permanent site on campus. The Department has participated in the University's KE Forum that shares best practice. It has also worked closely with key **University services** in developing Impact: eg the Enterprise, Knowledge and Exploitation Office (on consultancies); Continuing Professional Development Office (on CPD courses linked to M level programmes in conservation, façades and environmental design, eg the EuroCodes course above); Knowledge Transfer Partnership Office (on the KTP projects above); Research and

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Development Support Office (RDSO) (eg Sutton's secondment); the Public Engagement Office (on CASA activities); Corporate Communications (on publications and press releases, for example a series of BRE Information Notes). 19 staff attended University seminars on developing impact. We have utilised the University's Online Publication Store (OPUS), allowing free public access to papers, and civil engineering research at Bath is 5th in QS world rankings for 2013 for research citations (6th in 2012). Impact is also promoted via our research news on the University website.

c. Strategy and plans

The execution of work that is relevant to the 'real life' concerns of the building industry and the heritage sector is central to the Department's research and impact strategy. Our research aims to address key industry (and society) problems such as Low Carbon design, the sustainable and efficient use of building materials, and the preservation of historic structures. It is true to say that the vast majority of the Department's research output is directed towards these impactful ends. As a consequence we will actively seek to appoint academic staff and independent research fellows with a track record and further ambitions in industry-related, translational research. Our industrial board of advisors will continue to help ensure that our work maintains this relevance. Our strategy to engage with the construction industry will continue to be achieved through: industry sponsorship, KE and consultancy; our relationship with the BRE; our relationship with Modern Built Environment KTN; our relationship with the professions; our work on BSI committees (for example Harris on that for timber); continued interaction with University support units and initiatives (for example the KE champion and award scheme); interaction with the RDSO; and attendance at major industry exhibitions such as CICM's at EcoBuild & EDEN's at FutureBuild. Our capture of impact data and metrics to monitor this activity will be greatly enhanced through the University's recent adoption of a research information system (PURE). We aim to consolidate our status as one of the UK's leading centres of research into sustainable building materials and environments, with direct impact on the UK construction industry and professions at home and abroad.

d. Relationship to case studies

Generally: The Department encourages research impact via its centres; the four case studies offer strong evidence of the efficacy of this approach, since they reflect our core research themes (which are sustainability within CICM (with the BaleHaus and the life extension of concrete bridges), and public engagement and digital design within CASA). The impact described in the case studies reflects the Department's core commitment to research that is industry-relevant, and to its dissemination to non-academic audiences including the general public, the professions, and schools. Particularly, the case studies demonstrate our encouragement of staff to engage in KE work and public engagement as *outlined in section b above*, through funding time and potentially important activities before external funding has been secured. **More specifically** the impact described in the four case studies has been supported by the Department in the following ways:

'BaleHaus': the University has allocated land for the BaleHaus, and helped fund its relocation on campus in 2013 (£60K). The Department supports, in terms both of staff time and funding, the on-going partnership with ModCell, of which the BaleHaus is a key product. In 2010-2011 CICM completed a KTA Fellowship with the BRE, aimed at promoting wider uptake of renewable construction materials. This included a series of workshops with over 400 participants.

'Public Understanding': the University has supported the Department's public engagement agenda through the Public Engagement Unit and the RDSO. Time and funding is given for public engagement in all three centres, and in particular concerning history and conservation. The Sorbonne exhibition of 2009 described in the case study was partly funded by the Department.

'Concrete Infrastructure': the Department maintains well-equipped and staffed test labs, and computer facilities that helped produce TR55 and on-going consultancy for the Highways Agency. It has funded Darby's attendance at Concrete Society Steering Committees related to TR55.

'Clever Roofs': the Department hosts the Digital Architectonics MPhil Research programme cited in the case study, and provided computer facilities and funding for public engagement (Shepherd).