Project Reference: CTE_EMERC_ Hua_003_25_26

About the Project

This is an exciting PhD opportunity within the College of Technology and Environment (CTE) at London South Bank University (LSBU). The successful candidate will receive a tuition fee waiver beginning in September 2025 for 4 years, including the write-up year.

Project Title

Sustainable Geopolymer Concrete Using Recycled Construction and Demolition Waste for Low-Carbon, High-Performance Applications

Project Overview

Context & Challenge
The construction industry contributes significantly to global carbon emissions, with Portland cement production alone accounting for nearly 8% of global CO_2 output. As climate targets and sustainability regulations tighten, there is a pressing need for low-carbon alternatives that are not only technically sound but also scalable and cost-effective. Simultaneously, the industry must tackle the growing volume of Construction and Demolition Waste (CDW), much of which ends up in landfills.

Aim & Objectives
This PhD will develop and validate high-performance geopolymer concrete systems using recycled CDW as a major raw material. The research will:

1. **Design ternary and quaternary geopolymer formulations** incorporating recycled concrete, clay bricks, and ceramic tiles with supplementary materials like fly ash and GGBFS.
2. **Optimise mix designs** by adjusting key chemical ratios (e.g. SiO_2/Al_2O_3, Na_2O/SiO_2) and curing conditions to improve mechanical strength, thermal resistance, and durability.
3. **Conduct multi-scale characterisation** using XRD, SEM, and FTIR to evaluate the material's microstructure and hydration products.
4. **Undertake life cycle assessment (LCA)** to quantify carbon footprint, energy savings, and resource recovery benefits.
5. **Explore additive manufacturing potential** by assessing printability, rheology, and structural performance of 3D-printed geopolymer components.

Methodology & Innovation

- **Materials Innovation:** Use waste-derived aluminosilicates activated by alkaline solutions to produce binders with 60–70% less CO_2 than traditional cement.
- **Advanced Characterisation:** Apply state-of-the-art techniques to understand hydration chemistry, pore structure, and degradation resistance.
- **Circular Economy Integration:** Align outcomes with circular economy frameworks by valorising local CDW streams.
- **Additive Manufacturing:** Evaluate the feasibility of 3D printing for creating form-efficient and low-waste geopolymer elements.
- **Lifecycle and Impact Assessment:** Compare performance and sustainability of geopolymer systems versus conventional mixes using LCA metrics and industry benchmarks.

Impact & Application
Outcomes will guide the development of scalable, cost-effective geopolymer concrete for

infrastructure, housing, and offsite manufacturing. The project will provide data and insights to inform environmental policy, drive circular economy adoption, and reduce embodied carbon across the construction value chain. Collaborations with industry and standards bodies will support broader uptake of the technology.

Who Are We Looking For?

- Open to any UK or international candidates. Starting in September 2025.
- The candidate must meet the minimum entry requirements for our PhD programme by clicking the '[Apply](#)' link.

This PhD is suited to an ambitious and technically driven individual who wants to play a part in redefining the material foundations of the built environment.

Essential:

- A first or upper second class degree (or equivalent) in Civil Engineering, Materials Science, Chemical Engineering, or a related field
- Proven experience with cementitious or geopolymer materials
- Proficiency in lab-based material characterisation techniques (e.g. XRD, SEM, FTIR)
- Strong understanding of life cycle assessment (LCA) tools and metrics
- Excellent research design, data analysis, and project management skills
- Ability to work independently and collaboratively across disciplines

Desirable:

- Familiarity with sustainability frameworks, environmental product declarations (EPDs), or green certification schemes
- Experience with 3D concrete printing or advanced cementitious manufacturing
- Knowledge of alkali-activated materials chemistry or circular economy policy contexts
- Experience with software such as MATLAB, ANSYS, or rheology modelling tools

Selection Criteria:
- Academic Qualifications - You should normally have at least a 2.1 honours degree from a UK University or an equivalent qualification in engineering, computer science, etc.
- Research and Analytical Skills – Ability to research subjects using libraries, the internet, and other information resources, ability to conduct comprehensive literature reviews, experience in qualitative and quantitative data collection and analysis, strong research design and methodology skills, ability to independently collaborate with stakeholders, and excellent academic writing and communication skills.
- **Professional Skills -** Project management and organisational skills, ability to work independently and as part of a team, problem-solving and critical thinking skills, and adaptability and willingness to learn new skills.
- Software and Modelling Experience - Experience developing and utilising spreadsheet-based models (e.g., Microsoft Excel) to an advanced level. Experience with other software packages relevant to the discipline would be an advantage.
- Communication Skills—The candidate should be highly motivated, able to collaborate, have good visual, oral, and written communication skills, and communicate the work's outcomes to commercial, industrial, and scientific audiences.
- Teamwork and Collaboration - Ability to work with industrial and academic supervisors.
- Language Proficiency - Overseas applicants must have a minimum English language IELTS score of 6.5, with at least 5.5 in any of the components.
- Understanding of Equality and Diversity - Able to demonstrate an understanding of equality and diversity and their practical applications.

- Visa and Legal Requirements - Non-EU/EEA nationals may need to apply to the Foreign and Commonwealth Office (FCO) for clearance from the Academic Technology Approval Scheme (ATAS).

Training & Development Opportunities

Doctoral students at London South Bank University (LSBU), through the London Doctoral College (LDC), benefit from a rich and structured training environment designed to support academic excellence and professional development. All PhD candidates are offered a comprehensive programme of workshops and seminars covering essential research skills, including research design, data analysis, academic writing, ethics, and project management. These sessions aim to support students through every stage of their doctoral journey—from literature review and methodology to thesis completion and viva preparation. Postgraduate researchers can access advanced, discipline-specific training aligned with their research focus. LSBU's doctoral training environment is designed to build deep expertise in a chosen research area and the broader skills necessary for successful careers in research, industry, and beyond.

About the College

The College of Technology and Environment (CTE) at London South Bank University (LSBU) is a newly formed academic college, launched in January following the university's recent reorganisation. Led by Executive Dean Professor Chris Harty, CTE brings together four schools: Architecture & Planning, Construction, Property & Surveying, Engineering & Design, and Computer Science & Digital Technologies. The college fosters a collaborative and interdisciplinary environment, addressing the complex challenges of the built and digital environments. CTE strongly emphasises research, with doctoral students playing a key role in shaping and contributing to the college's research agenda. CTE prepares students to become future leaders through innovation, industry partnerships, and a commitment to sustainability. With a focus on real-world impact and academic excellence, the college is set to drive forward LSBU's vision of delivering applied knowledge that transforms lives and communities locally and globally. The university has five centres, and any academic staff and students in the college can join. These research centres are described below.

About the Bioscience and Bioengineering (BB) Research Centre

The Bioscience and Bioengineering Research Centre advances understanding of health and disease through biological research and innovative technologies. Our interdisciplinary team focuses on improving diagnostics, treatments, and patient management across healthcare settings. Areas of expertise include cancer biology, bioinformatics, pharmacokinetics/pharmacodynamics, microwave and ultrasound sensing, and image analysis. We also explore human biomechanics and the mechanical properties of muscle and tendon in both healthy and diseased states. By integrating science and engineering, we strive to translate cutting-edge research into real-world healthcare improvements that benefit patients and practitioners alike.

About the Building Future Communities (BFC) Research Centre

The Building Future Communities Research Centre supports inclusive, participatory research on real-world transformation and social justice. We work collaboratively with diverse stakeholders—charities, community groups, local authorities, and more—to co-create research with impact. Using an intersectional approach, our work spans funded research, enterprise, consultancy, and researcher development. BFC is a creative and unifying umbrella for projects prioritising community voice and engagement. Our goal is to drive positive change through research that reflects and responds to the needs and experiences of communities, with a clear commitment to inclusion, equity, and collaborative practice.

About the Digital x Data (DD) Research Centre

[Digital x Data Research Centre](#) is a university-wide interdisciplinary research centre exploring the impact and potential of digitalisation and datafication. We focus on cutting-edge AI and data science developments, addressing opportunities and challenges through a responsible, explainable, and sustainable lens. Rooted in LSBU's commitment to social justice, our research fosters equity by integrating science, technology, the arts, and the humanities. We drive innovation through applied research and strong partnerships with industry, academia, and the public sector and ensure that our work delivers real-world, transformative outcomes. Our approach is collaborative and future-facing, aiming to inform policy, practice, and public understanding.

About the Energy, Materials and Environment (EME) Research Centre

The [Energy, Materials and Environment Research Centre](#) leads interdisciplinary research on sustainable energy systems and material innovation. We address climate change by developing whole energy systems, spanning generation, storage, distribution, and consumption. Our research draws from materials engineering, policy, and societal impact to understand and influence the complex relationships between energy, economy, and society. With expertise in multiscale systems and cross-sector collaboration, we aim to shape policy and technology that supports the transition to a low-carbon future. Our work informs sustainable development strategies that balance environmental, economic, and social needs across local and global contexts.

About the Health and Wellbeing (HW) Research Centre

The [Health and Wellbeing Research Centre](#) promotes understanding how to protect and enhance health and wellbeing across all life stages. We focus on underserved populations and the services and professionals supporting them. Our research, grounded in social justice and inclusion, aims to reduce inequalities and improve outcomes through knowledge mobilisation and real-world application. Collaborating with academics across disciplines and health and social care partners, we explore lived experiences, service delivery, and workforce development. Our work informs policies and practices that support more effective, inclusive, and responsive health and social care systems.
For Enquiry

Contact Person

Before applying, please contact the main supervisor, **Hua Zhong Associate Professor in Sustainable Built Environment**, College of Technology and Environment.

E-mail: hua.zhong@lsbu.ac.uk

In your email, include:
- Details of your current level of study and academic background.
- A summary of any relevant experience.
- A brief paragraph about your motivation for pursuing this PhD project.

Fee Waiver

The fee waiver is available for 4 years (48 months), including the writing-up year, examination period, and submission of the corrected thesis.

How to apply

Applications should be submitted via the programme page using the links below:

https://www.lsbu.ac.uk/study/course-finder/construction-management-economics-phd

You should upload the problem statement, qualifications, CV, and other relevant documentation to the application portal. Remember to state the correct reference number and the appropriate supervisor.