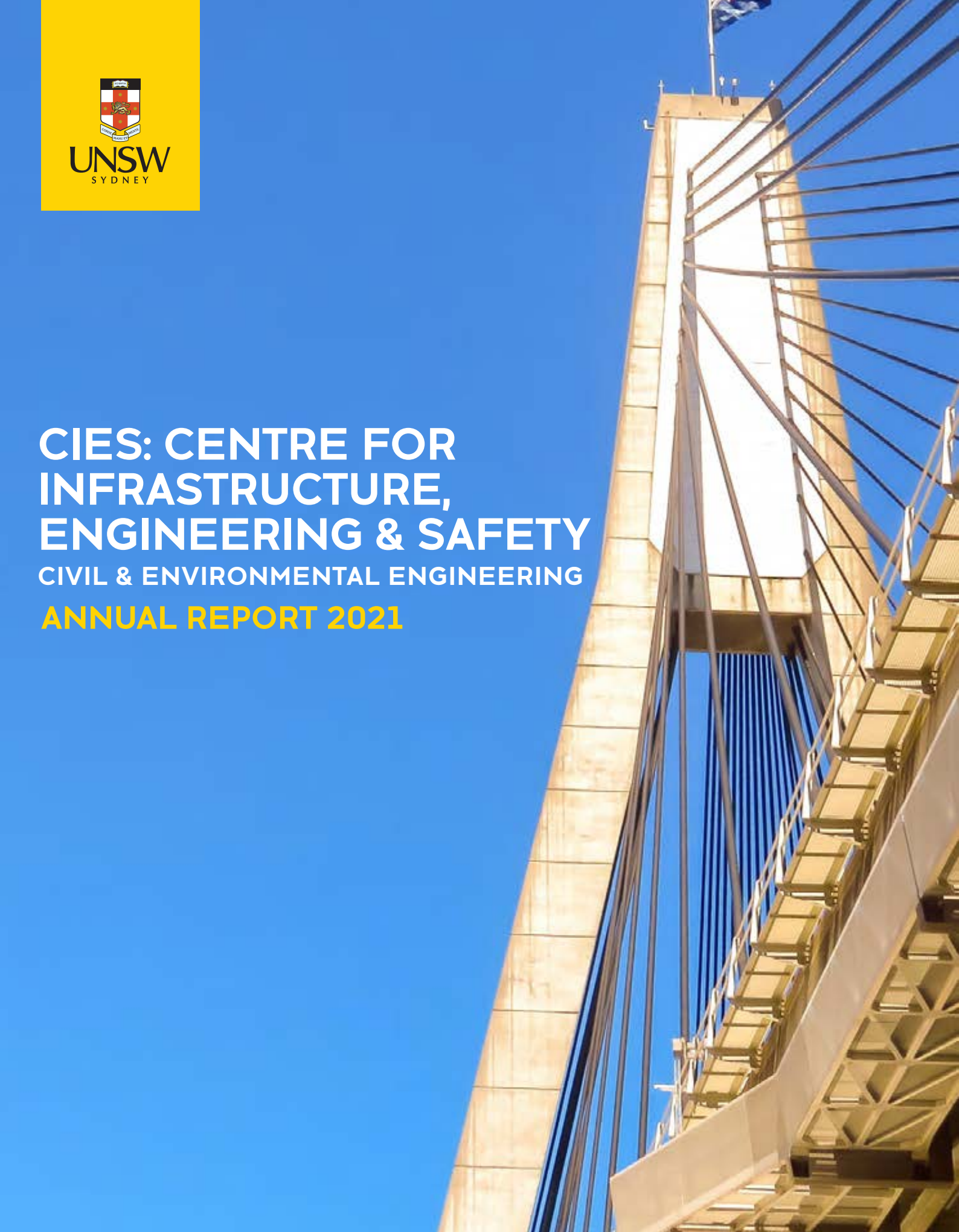
UNSW SYDNEY

CIES: CENTRE FOR INFRASTRUCTURE, ENGINEERING & SAFETY

CIVIL & ENVIRONMENTAL ENGINEERING

ANNUAL REPORT 2021



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SECTION 1

OUR CENTRE

OUR VISION

Our vision is to be the leading internationally recognised research centre in the region for investigating, understanding and predicting the safety and behaviour of engineering infrastructure under in-service and limit conditions.
We achieve this as an integral part of a circular economy, dedicated to high societal productivity and minimised waste.

We aim to be the nexus of the various scientific disciplines in the broad fields of engineering infrastructure; its design, evaluation, construction, performance, retrofit and reuse.

ABOUT US

WE CONDUCT PURE AND APPLIED RESEARCH

CIES was established as a University of New South Wales Research Centre in January 2007 to facilitate advanced research in all aspects of civil engineering infrastructure, including building structures, bridges, tunnels, roads, railways, pavements, dams, and the like. It has expanded to include construction management, advanced systems, and low-carbon technologies.

THE CORE activities of the Infrastructure Centre are underpinned by a significant number of eminent academic staff of international renown in their respective fields, particularly in structural engineering, geotechnical engineering, construction management, advanced materials engineering, pavement engineering, engineering mechanics, computational mechanics and in laboratory testing.

We conduct pure and applied research with funding won from National Competitive Grant Programs (particularly through the Australian Research Council's Discovery and Linkage Project Schemes) as well as other contestable funding programs, and with direct support from industry. We also undertake commercial activity in collaboration with industry that is challenging and strategic in its nature. These research and commercial activities are conducted with essential physical resources, such as those of the Heavy Structures Research Laboratory, Advanced Materials Research Laboratory, Geotechnical Laboratory, and our Advanced Computational Analysis Laboratory.

The composite of structural, geotechnical, construction and materials academics and researchers in the Infrastructure Centre is the leading group in Australia and in the region, with a demonstrated capability for delivery of research outcomes.

Ideally located at UNSW Sydney's School of Civil and Environmental Engineering, CIES projects incorporate several engineering disciplines – from structural engineering to geotechnical engineering to construction and management, and engineering materials to computational mechanics.

MULTI-DISCIPLINARY COLLABORATION FOR THE BEST RESULTS

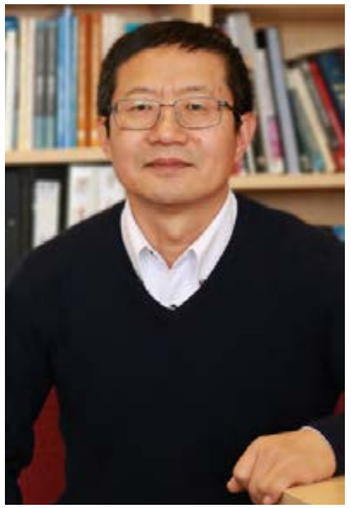
At CIES, we apply our skills to engineering and safety assessments of infrastructure. In particular, we look at the construction and risk management of buildings, bridges, dams, roads and other infrastructure when subjected to both in-service conditions and overload (or limit) conditions, such as in fire, earthquake, cyclone or blast situations, or when exposed to hostile environments and climatic variations.

The Centre aims to promote multi-disciplinary collaboration across the Faculties of Engineering, Science and the Built Environment at UNSW and to foster international and interdisciplinary research collaborations and partnerships with industry.

IN SHORT, CIES OFFERS:

- World-class interdisciplinary research by a team made up of structural and geotechnical engineers and scientists, and advanced systems and management personnel engaged in construction planning.
- Access to advanced analytical, computational and experimental techniques and facilities.
- A forum for idea exchange and research collaboration between engineers, scientists and planners.
- The ideal base from which to develop industry proposals and grant funding applications.
- Industry partnerships to secure the practical application of research outcomes.
- Opportunities for postgraduate students in a wide range of relevant disciplines.

WELCOME



I am proud to present this annual report on our achievements at the Centre for Infrastructure Engineering and Safety (CIES) during another challenging yet very successful year.

The report outlines the mission of the centre, its governance structure, and profiles our staff and their achievements. It also provides an overview of projects funded by competitive national schemes and industry, our laboratories, and the publications produced by staff and students throughout 2021.

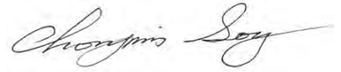
Our team's accomplishments during 2021 were undeniably impressive. Collectively our members were active on over thirty industry and government funded research projects, secured four new highly competitive Australian Research Council (ARC) Discovery Projects, graduated 9 PhD students, and published 144 refereed journal papers, 9 book chapters and one book.

CIES Deputy Director Scientia Professor Nasser Khalili secured $4.9 million in an ARC Industrial Transformation Research Program grant for a new research hub - Resilient and Intelligent Infrastructure Systems (RIIS) in Urban, Resources and Energy Sectors, which has several CIES researchers active as Chief Investigators.

In 2021 we welcomed Dr Rohit Tiwari to the geotechnical engineering team, while long term research associates Dr Babak Shahbodaghkhan and Dr Mohammad Vahab joined us on staff. At the end of 2021 we sadly farewelled our dynamic Centre Manager Theresa Wisniewski and welcomed Grace Zhu as our new Manager.

On behalf of the Executive Committee, I would like to thank all our staff and students who contributed so generously to the success of the Centre in the continuing pandemic, keeping our crucial laboratory research going and maintaining that equally vital ingredient of successful research – collegiality and collaboration.

I would also like to express my sincere appreciation and thanks to our industry partners and advisory committee members for your strong support and important contributions.



Professor Chongmin Song
CIES Director

CIES LEADERSHIP COMMITTEES 2021

EXECUTIVE COMMITTEE

The UNSW Centre for Infrastructure Engineering and Safety is managed by an Executive Committee comprising of the CIES Director, Research Director, Deputy Director and the Centre Manager. The committee meet on a regular basis to discuss strategy, performance and research opportunities. In addition, input to CIES management is provided by the CIES Academic Group.

Professor **CHONGMIN SONG**
Director

Scientia Professor **MARK BRADFORD**
Research Director

Scientia Professor **NASSER KHALILI**
Deputy Director

THERESA WISNIEWSKI
Centre Management

STEERING COMMITTEE

The Steering Committee meets throughout the year to oversee and monitor the progress of the Centre and to assist the Director in developing strategies to ensure that the goals and objectives of the Centre are realised. The membership of the Management Board for the Centre is:

- Professor Ian Gibson, Associate Dean, Faculty of Engineering (Chair)
- Professor Chongmin Song, CIES Director
- Scientia Professor Mark Bradford, CIES Director of Research
- Scientia Professor Nasser Khalili, Deputy Head of School
- Professor Klaus Regenauer-Lieb, School of Minerals and Energy Resources Engineering
- Scientia Professor Deo Prasad, School of Built Environment
- Professor Ismet Canbulat, School of Mineral and Energy Resources Engineering
- Professor Travis Waller, Head of School, School of Civil and Environmental Engineering
- Mrs Theresa Wisniewski, CIES Centre Manager

INDUSTRY ADVISORY COMMITTEE

The CIES is supported by an Industry Advisory Committee comprising of 12 members from industry and government organisations. The committee meet regularly with CIES academics to promote the engagement of CIES with Industry.

CIES IAC INDUSTRY MEMBERS 2021

Our accomplished and dedicated Industry Advisory Committee meets regularly with CIES academics to further promote our engagement with Industry.

GARRY MOSTYN
Chair
Principal, PSM

Garry Mostyn graduated from UNSW Australia in civil engineering in 1973. He subsequently completed a master's degree in geotechnical engineering at UNSW and a bachelor's degree in geology and statistics at Macquarie University. He worked as a cadet and engineer with the NSW Department of Public Works and with consulting geotechnical engineers from 1970 until 1986. He then joined the Department of Civil Engineering at UNSW Australia where he lectured in civil and environmental engineering practice and geotechnical engineering. He joined PSM in 1997 as a Principal Consultant while retaining a part time appointment at UNSW.

Garry's fields of specialist expertise include slope engineering; foundation engineering; rock mechanics; geotechnical risk analysis; and forensic engineering. He has authored or co-authored over 80 journal and conference papers. He has worked on major projects throughout Australia and in Thailand and PNG. He has been an active member of several national and international code and practice committees and been involved at the highest levels of the Australian Geomechanics Society and the International Society for Rock Mechanics.

JAMES ALDRED
Technical Director
Concrete Future/
AECOM and Adj A/
Professor - UNSW
Civil & Environmental
Engineering

James Aldred has over 30 years' experience In the concrete industry in Australia, Asia, the Middle East and the United Kingdom. His background includes Technical Director of an international admixtures company, Manager of the High-Performance Concrete Research Group at the National University of Singapore, Technical Manager of Taywood Engineering and Honorary Research Fellow at Imperial College. He is a specialist in concrete technology including mix design, durability, investigations and advice, with a proven record of helping change industry mindset and practices. He was the Independent Verifier for the Burj Khalifa in Dubai which is the world's tallest tower.

James obtained his PhD from Curtin University. He is a Chartered Professional Engineer and a Fellow of the Institute of Engineers Australia, the American Concrete Institute and the Institute of Concrete Technology. James has received the Award of Excellence from Concrete Institute of Australia and the Award for Outstanding and Sustained Contributions to Concrete Technology by ACI International Conferences, as well as the prestigious George Stephenson Medal.

PHIL BLUNDY
Technical Director, AECOM and Immediate Past Chair Engineers Australia, Structural College Board

Phil Blundy has nearly thirty years industry experience, at Hyder Consulting, then Cardno, and most recently at AECOM. As Technical Director at AECOM he has worked on projects for all levels of government and private agencies. Phil has been a member of Engineer Australia's Structural College Board for over ten years and is the Immediate Past Chair. He has been particularly involved in research and promotion of Australian Bridge Design Standards.

DR MURRAY CLARKE
Director, Structural Engineering APAC, Dematic, FIEAust CPEng NER APEC Engineer IntPE(Aus)

Dr Murray Clarke is Director of Structural Engineering at Dematic, a global engineering company that designs, builds and supports logistics solutions that optimise material and information flow.

After completing his PhD at the University of Sydney, Murray joined the academic staff to carry out teaching and research into steel structures, also at the University of Sydney. During this time he published widely in the field of advanced structural analysis and design of steel structures.

Murray moved to Dematic in 1999 to initiate the core discipline of structural engineering in that organisation. The main fields of Murray's current work include the design of storage racking and associated steel structures such as mezzanine floors to support Dematic's automated systems projects across the Asia Pacific region. Storage racks range in height from a few metres to more than 40 metres and make extensive use of cold-formed steel. In his current role, Murray has been fortunate to blend his academic interests with practical design and he maintains an active role in developing automated design tools for rapid and precise design of racking structures. Murray was a member of Standards Australia committee BD/62 responsible for developing AS 4084-2012 _Steel Storage Racking and is also a registered technical engineer with the European Racking Federation, a European industry body that develops design codes for the storage equipment industry in Europe.

KATHY FRANKLIN
Associate
Principal- ARUP

Kathy Franklin has worked on the structural design, analysis and forensic engineering on a wide variety of building and infrastructure projects. Her particular interest and expertise is in structural dynamics (vibration, blast, impact, seismic engineering), solving such problems as design for dancing crowds in pop concerts, pedestrian bridge vibration, lively office floors, achieving low vibration environments for sensitive equipment in laboratories and hospitals, wind, vehicle and machine induced vibration of structures. Projects that she is particularly proud to have been involved with include: Singapore Sports Hub, Kurilpa Bridge Brisbane; Marina Bay Sands Skypark; Sydney Cricket Ground Victor Trumper and Noble Bradman Stands; and "The Birds Nest" Beijing National Stadium. Kathy is passionate about education of the next generation of engineers, and research that will improve delivery of future projects. She regularly guest lectures at UTS, UNSW and USyd and has participated in a number of joint industry/ academia research projects.

JIM FORBES
Chairman Australian Standard Committee BD-002

Jim Forbes is Chairman of Australian Standard committee BD-002, responsible for AS 3600, the Australian Concrete Structures Code, and represents Australia on the International Standards Organisation TC71 committee.

With over 50 years in the construction industry, Jim has been involved with the planning, design, coordination and supervision of a wide variety of civil engineering and building projects.

His expertise covers Concrete Structures, Tall Buildings, Mining, Aerospace and Transport Infrastructure. Having developed considerable experience in transport projects, he applies a unique blend of building and transport skills to public and private transport projects across Australia.

His broad experience in civil engineering has seen him involved in projects which require holistic solutions to complex engineering, transportation and planning challenges. These have typically involved major infrastructure development projects, from initial master planning to completion.

Jim has extensive experience in running multidisciplinary teams and has an enviable reputation for identifying the winning elements of Design and Construct projects.

His acknowledged expertise in concrete and concrete structures led him towards a strong involvement with the Concrete Institute of Australia and the Federation Internationale du Beton and he has served as President of each of these organisations.

SAM HENWOOD
Director Pavements and Geotechnical Transport for NSW

Sam Henwood has been practising as a geotechnical engineer since graduating from UNSW in 1994 having worked extensively in both Australia and the United Kingdom in both the private and public sectors. Since 2016, he has led the Transport for NSW (formally Roads and Maritime Services) Pavement and Geotechnical section in his current role as Director Pavements and Geotechnical.

He is responsible for 55 professional staff with 5 direct reports and manages technical risk in pavements, geotechnical engineering, geoscience and materials disciplines. Sam is the Transport for NSW representative on the Austroads Pavement Task Force, managing technical development in pavement engineering. Sam has taken a lead in the use of recycled materials in road construction.

Prior to joining Roads and Maritime Sam worked as a consultant. He was responsible for the successful completion and management of geotechnical projects and has experience of geotechnical interpretation and design, pavement design, drainage design, client liaison, resource allocation, project planning, quality control and financial accountability.

He has worked on major infrastructure projects including highways, rail and ports, residential and commercial developments, local roads and tailings dam design. He has extensive experience in the UK rail sector particularly in Scotland and northern England.

He has also spent his formative years in an earthworks testing laboratory.

PETER KEY
National Technical Development Mgr., Australian Steel Inst.

Dr Peter Key is a structural engineer with upwards of 25 years' experience in R&D, design, site supervision and project implementation in a design & construct scenario for large steel buildings. His specialties include 3D design, structural design, research & development in construction. His interests have always encompassed the use of IT to bring efficiencies to the AEC industry.

Peter is Australian Steel Institute's National Technical Development Manager and a regular presenter on steel design and construction. He is part of Standards Australia Committee BD-001 responsible for the new AS/NZS 5131 Steel structures - Fabrication and erection. He has also written a range of technical publications including the Structural steelwork fabrication and erection Code of Practice on which AS/NZS 5131 is based.

ROD MCKAY-SIM
Director, Hillside Engineering Pty Ltd
Member, Concrete Institute of Australia

Rod McKay-Sim has been involved in engineering innovation all his professional career. In the 1990s he grew a small agency based company from less than $500K turnover to a strong, profitable business of sales exceeding $30million and operations throughout Australia, New Zealand and Singapore by introducing six ground-breaking engineering technologies (now considered standard practice) in Australia and New Zealand: Since 2006 he has led his own company in innovative research and practise - professional specialties are Concrete Lifting and Anchoring Systems design and technology, Tilt-Up construction systems, and Pre-cast concrete lifting systems. Since 2003 Rod has also been a keen cyclist for charity, five times finisher in the Hartly Challenge (Canberra-Charlottes Pass-Canberra) raising money for Hartley Lifecare - helping disabled people lead happy and productive lives, and a regular in the Sydney to Surfers cycle ride, raising money for Youth Off the Streets.

JOHN MERRICK
Snr Tech Director ARCADIS Aus.Pacific
METRON - Barangaroo Stn Design Mgr

John Merrick has over 20 years' experi-ence in various types of structures including residential, commercial, retail, educational, health, recreational, stadiums and transport infrastructure in Australia and overseas. He has presented papers at engineering conferences both in Australia, United Kingdom and USA. John is a committee member on BDS - 032 - Composite Structures and BDS-01 Steel Structures.

Some of John's projects include METRON - Underground Station Design and Technical Services

(USDTS) Sydney Metro project; West Connex - Building Zone Manager - Responsible for the structural, civil and building services design for all buildings in Stage 1B including 3 ventilation stations, 6 substations, MMC office building, 2 fire pump buildings and 4 tolling buildings;. Barangaroo South -6 storey commercial and 4 storey mixed usage buildings; Australian Embassy in Kathmandu and New Delhi - detailed inspections following 2015 earthquake; Dubai Tower Doha Project manager and design engineer for 88 storey tower currently under construction; Al Harma Tower - project manager for peer review of 413m tower in Kuwait; Port of Townsville - design manager for berth expansion; Inghams Sommerville - design of new steel industrial buildings.

WARREN SOUTH
Director- Research & Tech Services at Cement Concrete & Aggregates Australia

Dr Warren South has worked in the heavy construction materials industry for the past 35 years. He started his working career in cement in 1985 with Blue Circle Southern Cement at Berrima as Assistant Works Chemist, later to become Works Chemist in 1989. During this time he worked on the development of cement and concretes specifically for high durability applications such as the immersed tube units for the Sydney Harbour Tunnel and other important infrastructure projects. As Technical Manager for NZ's Golden Bay Cement he led the development of cements specifically for use in the South Pacific, and the development of inorganic polymer binders for concrete. He gained his doctorate in Civil Engineering from the University of Wollongong in 2010, dealing with the performance of cements based on natural pozzolanic materials available in New Zealand. Warren maintains an active focus on addressing sustainability and resilience in terms of the cement and concrete industry and is a strong advocate for the positive contributions that concrete can make to the durability of the built environment.

CIES STAFF MEMBERS OF THE IAC

Professor **CHONGMIN SONG**, Director, CIES

Scientia Professor **NASSER KHALILI** Deputy Director, CIES

Professor **WEI GAO**

Associate Professor **HAMID VALIPOUR**

Scientia Professor **MARK BRADFORD** Research Director, CIES

Professor **STEPHEN FOSTER**

Professor **ADRIAN RUSSELL**

Associate Professor **EHAB HAMED**

CIES ARC DISCOVERY GRANTS

Seven CIES academic staff were successful in securing four new ARC Discovery Project (DP) grants commencing in 2022. Three of the DPs – with a total value of just over $1 million - are led and administered by CIES, and the fourth is led by colleagues at UTS. Congratulations to all involved for this outstanding achievement!

The successful grants are as follows (with CIES staff listed in bold)

Non-differentiable Energy Minimisation For Modelling Fractured Porous Media. DP220104021

Investigators: **Professor Nasser Khalili; Dr Mohammad Vahab; Dr Asal Bidarmaghz;** Dr Mohammadreza Hirmand
Amount Awarded: $373,000

This project is aimed at advancing theoretical, computational and experimental bases for the fracturing of geomaterials, and providing scientists and engineers with much needed predictive tools for quantitative assessment of the responses. By incorporating previously neglected aspects such as energy minimisation, advanced constitutive modelling, and non-planar interacting fracture growth, confidence in the design and planning of engineering processes in fractured porous media will be increased to the point that costly over/under designs are avoided.

Through the use of the tools developed, it will be possible to detect weaknesses in the design, assess the impact and implement effective measures to improve performance.

Torsion in innovative timber composite floors. DP220101038

Investigators: **Associate Professor Hamid Valipour; Professor Mark Bradford**
Amount Awarded: $340,000

Application of lightweight sustainably sourced timber panels combined with steel beams or reinforced concrete slabs in composite floors has the potential to significantly improve the speed and efficiency, and reduce the carbon and energy footprint of the construction industry. This project aims to produce world-first benchmark experimental data and advanced numerical and simple analytical models required for efficient, yet safe and reliable analysis and design of timber-concrete and steel-timber composite floors subjected to complex 3-dimensional loading scenarios that involve combinations of torsion, bending and shear.

The outcomes are expected to promote innovation and advance knowledge in the field of structural mechanics.

Self-Healing Concrete for Mitigation of Chloride Induced Steel Corrosion. DP220101051

Investigators: Professor Arnaud Castel; Dr Wengui Li; **Dr Taehwan Kim**
Amount Awarded: $220,000

This project aims to develop an intrinsic self-healing concrete using crystalline admixtures for rapid healing of concrete cracking. In marine environments, concrete cracking provides a direct access for chlorides from sea water to the steel reinforcement, leading to early and severe steel corrosion. The self-healing concrete will be designed to address the two main causes of concrete structures deterioration in Australia: early age cracking due to restrained shrinkage and chloride induced steel reinforcement corrosion.

The outcomes of this project will drive the advances in developing and applying crystalline admixture-based self-healing concrete to extend the service life of concrete structures and avoid costly repair.

Connections for hybrid steel-timber-concrete structures. DP220100841

Investigators: **Associate Professor Hamid Valipour; Professor Stephen Foster**
Amount Awarded: $318,000

Connections play a vital role in overall performance, reliability, and adaptability of civil structures. This project aims to develop innovative, easy to fabricate and efficient connections for hybrid structural systems that fully exploit advantages of steel, concrete and engineered timber to reduce the self-weight, cost and negative environmental impact, and enhance opportunities for deconstruction, reusing and upgrading of structures. Structural performance of the connections will be assessed by laboratory testing and advanced numerical modelling

Comprehensive knowledge on stiffness, strength, and ductility and world-first provisions for safe and cost-effective design of the hybrid steel-timber-concrete structures will be generated.

AWARDS & ACHIEVEMENTS

CIES Professor Stephen Foster appointed as Dean of Engineering.

In 2021 CIES Professor Stephen Foster was appointed as Dean of UNSW Engineering. He had been Acting Dean since January 2020 and was previously Head of the School of Civil & Environmental Engineering (2013-2020). Prior to that Stephen was Director of CIES from 2010 to 2013.

Professor Foster said he was proud and delighted to take on the role permanently and is looking forward to building on more than 70 years' worth of history in a faculty that offers the widest choice of engineering programs of any university in Australia.

"This is an exciting time to be taking on the role of Dean," Professor Foster said. "Engineers advance all of humanity and as the world becomes more complex, I am honoured to represent our faculty as it works to solve global challenges. As actions to address the challenges of our changing climate become even more urgent, and innovation more necessary than ever, as Dean, I aim to ensure we will continue to transform and innovate."

"Engineers advance all of humanity and as the world becomes more complex, I am honoured to represent our faculty as it works to solve global challenges."

Professor Foster received his PhD from UNSW in 1993 and has a distinguished record in the field of structural concrete and concrete materials. He has over 350 publications in the field of structural concrete. His main research interests are in the fields of bringing new materials technologies to the design of concrete structures, including fibre and ultra-high-performance concrete, low carbon construction materials such as Geopolymer, and alkaline activated concretes and high strength reinforcing steels.

He is a Fellow of Engineers Australia, Fellow of International Federation for Structural Concrete (fib), Honorary Member of the Concrete Institute of Australia (CIA) and a member of several Australian and international Standards Committees. He is Deputy President of the fib and member of the fibPresidium.

CIES Research Triple Win from The Australian

In 2021 The Australian newspaper's annual Research Magazine named

- CIES Professor Xiao Lin (Joshua) Zhao as Australia's top researcher in the field of civil engineering,
- CIES Research Associate Dr Junqi Zhang as one of the nations' top 40 rising research stars, and
- UNSW as the top research institution in the field of structural engineering.

Congratulations to Professor Zhao, Dr Zhang and all the outstanding structural engineering academics and researchers based in our Centre.

"ATSE Fellows are shaping Australia's future"

Professor Zhao, Associate Dean International, UNSW Engineering, was also elected as a new Fellow to the Academy of Technology and Engineering (ATSE), an independent body of almost 900 eminent Australian scientists and engineers. ATSE President, Professor Hugh Bradlow said the new Fellows are front-runners in growing Australia's standing as a top technologically driven nation. "ATSE Fellows are shaping Australia's future," he said.

"One of the nation's top rising research stars"

Professor Zhao is known internationally for his work improving the resilience and safety of engineered structures. He leads research into sustainable alternatives to cement, the world's single largest industrial cause of carbon pollution, including work on concrete utilising seawater, sea sand, recycled aggregate and industrial waste such as slag and fly ash.

Dr Zhang's research impact lies in the field of high-performance computing in structural dynamics, a major research strength at CIES. Dr Zhang and his colleagues' research is dedicated to the development of new parallel numerical simulation tools so that engineers can design and analyze structures with less effort. In this numerical framework, the geometric model, represented by multiple data formats, including digital image, 3D printing, and point-cloud, can be discretised for numerical simulation automatically, which circumvents one of the most notorious bottlenecks in the current modeling process.

Industry Classic Revised.

In 2021 the third edition of industry classic *Reinforced Concrete Basics* was released, authored by CIES Professor Stephen Foster, with colleagues Dr Andrew Kilpatrick and Emeritus Professor Robert Warner of the University of Adelaide.

It provides an up-to-date, practical treatment of reinforced concrete design in accordance with the current, amended edition of the Australian Concrete Structures Standard AS 3600, and takes account of latest industry developments, including the use of high-strength concrete and higher-strength reinforcing steel.

This third edition became necessary because of important changes recently made to AS 3600. These include new approaches to calculating crack widths and to design for shear and torsion, as well as changes in the capacity reduction factors (φ), and hence the implied safety levels in the AS 3600 design procedures.

Reinforced Concrete Basics has been written for students and practising structural engineers. The concepts of analysis and design are presented from a fundamental viewpoint so that the text will be of value to readers using other codes and standards.

New ARC Hub for Resilient and Intelligent Infrastructure - RIIS

In 2021 CIES Professor Nasser Khalili secured $4.9 million in an Australian Research Council (ARC) Industrial Transformation Research Program grant for a new research hub - Resilient and Intelligent Infrastructure Systems (RIIS) in Urban, Resources and Energy Sectors.

The ARC Industrial Transformation Research Program supports collaborative research activity between industry and the Australian higher education sector, and RIIS, with its seventeen industry and four university partners aims to deliver technologies that will address Australia's infrastructure needs in the urban, energy and resources sectors. The hub will integrate sensor technology, connectivity, data analytics, machine learning, robotics, smart materials, and reliable models.

CIES researchers involved as Chief Investigators in the visionary hub include Professor Wei Gao, Dr Babak Shahbodagh, Dr Johnson Shen, and Dr Mohammad Vahab.

Australia's critical infrastructure and physical assets such as buildings, roads, bridges, rail lines, tunnels, utilities, processing plants, mines and refineries form the backbone of national productivity. However according to the Australian Infrastructure Audit, our ageing assets have been put under growing strain.

With demand for new infrastructure in all sectors for our growing population, combined with impacts of climate change and aging infrastructure, there is an increasing need, says Hub Director UNSW Scientia Professor Nasser Khalili, "for new technologies to predict infrastructure rehabilitation and renewal needs, pre-empt failure and prolong life as well as for new systems to deliver sustainable, resilient, and cost-effective infrastructure.

"The hub will solve industry challenges and translate research ..."

"A frontier arena of research, the hub will provide a fully integrated platform for the development and delivery of next-generation digital technologies for Australia's infrastructure. The technologies will enable design, real-time performance analysis and life-management of infrastructure.

"The hub will solve industry challenges and translate research and development into commercial opportunities and outcomes.

"RIIS will leverage a suite of innovative and integrated technologies," he says, "to monitor, model and improve our urban infrastructure, transport, water, resource, and energy management in order to achieve economic, low-carbon, and sustainable development."

Led by Professor Khalili and with Professor Abbas Rajibifard, Director of the University of Melbourne's Centre for Spatial Data Infrastructures and Land Administration (CSDILA) as RIIS Deputy Director, the Hub will draw strength from world class engineering and scientific research expertise at UNSW Sydney, University of Melbourne, Queensland University of Technology, and Western Sydney University, as well as a wide range of experienced industry partners. Hub funding is for 5 years and includes $5 million from the ARC, $5.7 million from industry and $1.3 million from the university partners.

For more information see https://riis.org.au

CIES Professor Nasser Khalili has been appointed as a Scientia Professor by UNSW.

Nominated by their peers and selected based on an impressive portfolio of international research success, Scientia Professors embody UNSW's highest values, including leadership, innovation, creativity, teamwork and, above all, excellence.

"Nasser has graciously provided long-term service through pivotal School and Faculty leadership roles..."

As Head of School of Civil & Environmental Engineering Professor Travis Waller said, in announcing the news in August 2021, "This is a massive achievement and is in recognition of Nasser's exceptional performance across the full spectrum of academic activity - teaching, research, leadership and engagement.

"In addition to being an absolute leader of research and teaching, Nasser has graciously provided long-term service through pivotal School and Faculty leadership roles in addition to numerous critical University and professional committees."

About Nasser: Scientia Professor Khalili's publications are prolific, awarded, often cited, and highly regarded, particularly his work in unsaturated soil mechanics and computational geo-mechanics. He is credited with the development of the first thermodynamically consistent framework for constitutive modelling of unsaturated porous media. Similarly, his research into the mechanics of double porosity media has set an international benchmark in numerical modelling of fractured porous media.

Nasser sits on three international editorial boards, numerous industry and university bodies and has been a visiting or honorary academic in China, France, the UK, USA and Canada.

SECTION 2

OUR PEOPLE

PHD RESEARCHER AYESHA SIDDIKA

ACADEMIC STAFF

ATROSHCHENKO, ELENA
Senior Lecturer
MSc in Mechanics and Applied Mathematics, Saint-Petersburg State University
PhD in Civil Engineering, University of Waterloo, Ontario

Research Interests: Lie in the area of Computational Mechanics and Numerical Methods, with application to fracture mechanics, acoustics, bending and vibration of composite plates.

BRADFORD, MARK
UNSW Scientia Professor
BSc BE PhD USyd DSc UNSW FTSE CPEng CEng PE Dist.MASCE FIStructE FIEAust.

Research Interests: High-strength steel structures, steel-concrete composite structures, steel-timber hybrid structures, concrete structures, arches, geometric non-linearity, pavement thermo-upheaval buckling, railway thermo-lateral buckling, design for deconstructability, low-emissions structural paradigms, forensic engineering.

BIDARMAGHZ, ASAL
Lecturer
PhD Civil Engineering (Geothermal Technolo-gies) University of Melbourne

Research Interests: Energy geo-structures and geothermal systems, Investigating the impacts of urbanization on subsurface temperature increase at the city-scale, Uncertainty analysis of large scale subsurface hydro-thermal models.

DACKERMANN, ULRIKE
Lecturer
Dipl.-Ing. Univ., Technical University of Mu-nich (TUM), PhD UTS

Research Interests: Structural Health Monitoring, Non-Destructive Testing, Damage Detection, Structural Dynamics, Artificial Intelligence, Timber Engineering.

DAVIS, STEVEN
Senior lecturer
Chair, Teaching & Learning Committee BE PhD UNSW

Research Interests: Online Assessment, Virtual Reality, Project Scheduling, Safety, Construction Defects and Rework.

DOUGLAS, KURT
Pells Sullivan Meynink Senior Lecturer of Rock Mechanics,
Chair External Relations
BE (Hons1) USyd, PhD UNSW

Research Interests: Lie in the field of rock mechanics and dam engineering. Predicting field properties of rock masses continues to be a major challenge for us to address. My dams research focusses on spillway erosion and backward erosion of dams.

EISENTRAGER, SASCHA
Lecturer
Doctor of Engineering (Computational Mechanics), Otto von Guericke University Magdeburg, Germany

Research Interests: Sascha's research is within the context of structural health monitoring (SHM) applica-tions, particularly with the development of efficient numerical methods for the analysis of wave propagation phenomena in thin-walled structures. Therefore, the propagation of elastic guided waves (Lamb waves, Love waves, Rayleigh waves, etc.) is an important area for his innovative high order finite element and fictitious domain approaches.

FOSTER, STEPHEN
Professor and Acting Dean of UNSW Engineering, BE NSWIT, MEngSc PhD UNSW, MIEAust, FIEAust

Research Interests: Behaviour of structural systems (buildings and bridges) constructed of reinforced and prestressed concrete. I'm particularly interested in bringing new and advanced materials technologies to the engineering of structures. My interests are in the use of high and ultra-high performance concretes, fibre-reinforced concretes and geopolymer concretes and in use of carbon fibre technologies for strengthening and repair of structures and structural systems. I develop physical-mechanical models for use in advanced computational and numerical tools such as FEM and for their use in the study of behaviour of concrete structures that are subjected to extreme events.

GAO, WEI
Professor
BE HDU, ME PhD Xidian, MIIAV, MAAS

Research Interests: Uncertain modelling & uncertain methods: Vehicle-bridge interaction dynamics: Wind and/or seismic induced random vibration: Train-rail-sleeper-foundation-tunnel/ bridge system: Stochastic nonlinear system: Vehicle dynamics & vehicle rollover: Structural optimization & control: Smart structures: Stability & reliability analysis.

HAJIMOHAMMADI, AILAR
Senior Lecturer
Ph.D. University of Melbourne

Research Interests: Examines the chemistry of materials to develop innovative construction elements with attractive properties. She is also investigating waste management and resource recovering strategies towards the circular economy in civil and construction projects.

HAMED, EHAB
Associate Professor
BSc MSc PhD Technion

Research Interests: Viscoelastic behaviour of materials and structures, strengthening of structures with FRP composite materials, sandwich panels.

HOLDOM, ROBERT
Senior Lecturer

Research Interests: Construction management.

KASHANI, ALIREZA
Lecturer
BSc, MSc Amirkabir University of Technology, Tehran
PhD University of Melbourne

Research Interests: Lecturer and Churchill Fellow in Sustainable Construction Automation and 3D Printing with extensive experience in research, development, and commercialisation of advanced and sustainable construction materials. Research areas include development of novel high-performance materials and techniques for construction 3D printing, and sustainable construction materials for the 'Circular Economy' including wastes valorisation, low-carbon construction materials and sustainable concrete.

KHALILI, NASSER
UNSW Scientia Professor
BSc Teh, MSc Birm, PhD UNSW

Research Interests: Mechanics of unsaturated soils: Flow & deformation in double porosity media: Numerical methods applied to geotechnical engineering: Pavement engineering.

KHOSHGHALB, ARMAN
Senior lecturer
BEng, MEng, Sharif University of Technology, Tehran, PhD UNSW

Research Interests: Mechanics of unsaturated soils, coupled analysis of porous media, advanced numerical methods in geomechanics, modelling discontinuities in porous media, large deformation analysis in geomechanics, stabilisation techniques in computational geomechanics, constitutive modelling of geomaterials, dynamic properties of geomaterials.

KIM, TAEHWAN
Lecturer
BSc, MSc KAIST, PhD Purdue USA

Research Interests: Advanced and sustainable infrastructure materials: Thermodynamics in cementitious materials and the modelling of their chemical process: Advanced materials characterization techniques: fundamental understanding of chemo-physical reactions in cementitious materials: Microstructure evolution of cementitious materials: Utilizing natural and waste materials to develop low carbon foot-print materials.

MAKKI ALAMDARI, MEHRISADAT
Lecturer
BSc Sharif, MSc Iran University of Science and Technology, Mech Eng
Manitoba, PhD UTS

Research Interests: Structural Health Monitoring, vibration analysis and testing, structural dynamics, inverse dynamic problems, signal processing and data mining. Mehri is on the Executive of the Australian Network of Structural Health Monitoring (ANSHM), and a member of The International Society for Structural Health Monitoring of Intelligent Infra-structure (ISHMII).

RUSSELL, ADRIAN
Professor
BE, PhD UNSW, PGCert Bristol

Research Interests: Applied unsaturated soil mechanics; Liquefaction of variably saturated soils and tailings; Fundamental modelling of soils linking microstructure to large scale behaviour; Fundamental rock mechanics: Fibre reinforced soils.

SHAHBODAGHKHAN, BABAK
Lecturer
MSc Uni of Tehran, PhD Kyoto University

Research Interests: Computational Geomechanics, Dynamics of Unsaturated Soils, Constitutive Modelling of Geomaterials, Seismic Analysis of Geostructures, Dynamic Soil-Structure Interaction.

SHEN, JOHNSON XUESONG
Senior Lecturer
BEng, MSc Nanjing, PhD Hong Kong Polytechnic University

Research Interests: Digital Twins, Artificial Intelligence, Smart Sensing, Autonomous Systems, Internet of Things, Mixed Reality, and their applications in the construction, operation, and maintenance of civil infrastructure and built environment.

SONG, CHONGMIN
Professor and Director CIES
BE ME Tsinghua, DEng Tokyo

Research Interests: Scaled Boundary Finite-Element Method, Mesh Generation, Dynamic Soil-Structure Interaction, Structural Dynamics & Earthquake Engineering, Fracture Mechanics, Elasto-Plastic-Damage Constitutive Modelling.

TIWARI, ROHIT
Lecturer
MEng Indian Institute of Technology,
PhD Uni of Melbourne

Research Interests: Geotechnical Earthquake Engineering, Performance Based Seismic Design of Geo-structures. Rohit has a strong background in experimental investigations of seismic actions in Earth Retaining Structures and calibration of numerical non-linear material models.

VAHAB, MOHAMMAD
Lecturer
PhD Sharif University of Technology

Research Interests: Numerical simulation by employing the state-of-the-art computational methods, specializes in the hydro-mechanical coupling processes in saturated/unsaturated porous formations. This involves the development of physical models as well as advanced computational frameworks in relation to the hydraulic fracturing treatments in neat, fractured and/or layered domains.

VALI POUR GOUDARZI, HAMID REZA
Associate professor
BE, MEngSc, PhD UNSW

Research Interests: Structural mechanics; De-elopment of innovative hybrid steel-timber-concrete structures with emphasis on sustainability and improved structural performance; Behaviour of structures subjected to extreme loads such as earthquake, impact, blast and explosion: Computational mechanics and non-linear finite element modelling of structures: Constitutive modelling of materials.

ZHAO, XIAO LIN (JOSHUA)
Professor and Associate Dean (International), Faculty of Engineering
BE, ME Shanghai Jiao Tong University, PhD and Doctor of Engineering, USyd
MBA (Executive) UNSW/USyd

Research Interests: Current research focuses on hybrid construction utilising seawater, sea sand concrete and fibre reinforced polymers; rehabilitation of aging infrastructure using advanced composite materials; and ultra-high strength steel structures.

EMERITUS PROFESSORS

CARMICHAEL, DAVID

FELL, ROBIN

GILBERT, IAN

TIN LOI, FRANCIS

VALLIAPPAN, SOMASUNDARAM

CENTRE RESEARCH STAFF

CIES Staff

Al-Damad,Iman Munadhil Abbas	Research Associate
Ankit	Research Associate
Chen, Xiaojun	Research Fellow
Chhor, Allen	Senior Research Associate
Elhadayri, Farj	Research Associate
Liu, Xinpei	Senior Research Associate
Mahmood, Aziz Hasan	Research Associate
Mohseni, Ehsan	Research Associate
Saputra, Albert	Research Associate
Zhang, Junqi	Research Associate

Visiting/Adjunct Academics

Aldred, James	Adjunct Associate Professor
Eisentrager, Johanna	Visiting Fellow

PROFESSIONAL AND TECHNICAL STAFF

Technical Services - Kensington

PAUL GWYNNE
Lab Manager

RUDINO SALLEH
Senior technical Officer

TIMOTHY WESTON
Technical Officer

LUIZ PETTERSEN
Technical Officer

WILLIAM TERRY
Senior Technical Officerr

Technical and Professional - Heavy Structure Laboratory Randwick

DR ZHEN-TIAN CHANG
Laboratory Manager

SANJEEWA HERATH
Senior Technical Officer

TUAN LE
Technical Officer

RONALD MONCAY
Senior Technical Officer

GREG WORTHING
Technical Officer

Research Centre Management

THERESA WISNIEWSKI
CIES Manager
till 12 Dec 2021

GRACE ZHU
CIES Centre Manager
from 13 Dec 2021

WELCOME NEW STAFF

A warm welcome to Dr Rohit Tiwari who joined CIES in March 2021.

Rohit's primary research interests lie in the areas of Geotechnical Earthquake Engineering and Performance Based Seismic Design of Geo-structures. He has a strong background in experimental investigations of seismic actions in Earth Retaining Structures and calibration of numerical non-linear material models. He is keen to understand the performance of Geo-structures in dynamic loading conditions for ensuring a safe and reliable Infrastructure system.

His PHD in Infrastructure Engineering (2020) gained at University of Melbourne was on the topic of Displacement Based Seismic Assessment of Earth Retaining Structures. During his candidature, Rohit won the Best student paper award from the Australian Earthquake Engineering Society (AEES) in 2018.

Rohit has also worked with industry and gained experience in construction and structural design projects. Having a strong interest in academic teaching he has taught undergraduate and postgraduate courses in Australia and in India. While teaching Rohit always tries to relate the concepts with the learnings from industry and research so that the students can develop a better understanding and realistic imagination of field conditions..

Two CIES research associates also recently joined the academic staff.

Dr Babak Shahbodaghkhan is a young researcher with expertise in the numerical and constitutive modelling of multiphase porous media.

He received his PhD in Geotechnical Engineering from Kyoto University, Japan, under the supervision of Professor Fusao Oka. He was awarded the Monbusho Scholarship for his PhD program from the Ministry of Education, Science and Technology, Japan.

His research interests include computational geomechanics, dynamics of unsaturated soils, constitutive modelling of geomaterials, seismic analysis of geo-structures, and dynamic soil-structure interaction. The outcomes of his research in these areas have been published in top-ranked Q1 journals in the field.

Dr Shahbodagh is the developer of a computational model for the nonlinear dynamic analysis of flow and deformation in multiphase porous media. The framework considers the effects of large deformation, viscoplasticity, and mechanical and hydraulic hystereses, essential for prediction of the large deformation and pre- and post-localisation behaviour of partially saturated geo-structures subjected to seismic loading.

He is also credited with the development of a novel analytical-numerical method for the dynamic analysis of deep foundations in non-homogenous anisotropic soils.

Dr Mohammad Vahab received his PhD in Civil Engineering from Sharif University of Technology in 2015. He then joined UNSW as a research associate in Geotechnical Engineering.

The focus of his research is numerical simulation by employing the state-of-the-art computational methods, namely:

- Extended Finite Element Method (XFEM); and,
- Non-differentiable Energy Minimisation using Discontinuous Galerkin Method (DG).

Mohammad specializes in the hydro-mechanical coupling processes in saturated/unsaturated porous formations. This involves the development of physical models as well as advanced computational frameworks in relation to the hydraulic fracturing treatments in neat, fractured and/or layered domains.

More recently, Mohammad has been investigating the use of deep learning in the study of complex mechanical response of geo-infrastructures by means of the Physics-Informed Neural Networks (PINNs). He is a Chief Investigator (CI) in the Research Hub on Resilient and Intelligent Infrastructure Systems (RIIS).

RIIS aims for sustainability, serviceability, resilience, planning, decision making, and safe operations. Mohammad contributes to the hub in discovery, inversion, and data processing with the purpose of health monitoring of infrastructures across Australia, which is a key to sustainability in engineering design and practice.

CIES welcomes new Centre Manager, Grace Zhu

Grace Zhu joined CIES as new Centre Manager in December 2021.

Grace has been with UNSW for over ten years. Her experience includes six years in the Engineering Faculty Finance team and four years with Research Finance. Grace has extensive knowledge of research grant management and finance.

Grace says she is looking forward to her new role at CIES, “I am very excited with my new role and look forward to working with everyone at the Centre to ensure the smooth operation of CIES.

"I am very excited with my new role and look forward to working with everyone at the Centre..."

“I am hopeful that my skills and experience can assist CIES staff on the financial management of their research funding commitments.”

As a multi-million dollar grant winning research centre, CIES is delighted to have Grace with us on our continually expanding journey.

Grace replaces Theresa Wisniewski who has taken up the exciting role of Business Manager of the new ARC Industry Transformation Research Hub – RIIS. Resilient and Intelligent Infrastructure Systems (RIIS) in Urban, Resources and Energy Sectors.

Thank you, Theresa, for all your great work for us, and a big welcome to Grace!

PHD GRADUATES 2021

AMRAEI, MOHSEN
Supervisor: Joshua Zhao
CFRP Strengthening of Welded High and Ultra-High Strength Steels

ANKIT, ANKIT
Supervisor: Chongmin Song
High-performance computing for impact-induced fracture analysis exploiting octree mesh patterns

BAKTASH, NOOR ADNAN SADIK
Supervisor: Nasser Khalili
Experimental Investigation of Creep in Unsaturated soils

FENG, YUAN
Supervisor: Wei Gao
Dynamic Behavior Of Structures With Uncertain Parameters Under Random Process Excitations

HADSARI, VIENTI
Supervisor: Adrian Russell
The influence of wetting and drying on the pore size distribution, water retention, compressibility and liquefaction susceptibility of a silty sand

KHOSHINI, MOHAMMAD
Supervisor: Nasser Khalili
Experimental investigation and analytical modelling of weak rocks subjected to mechanical degradation

QU, YANLING
Supervisor: Chongmin Song
Seismic analysis of gravity dam-reservoir-foundation systems using scaled boundary finite element method

YONGZHI, XU
Supervisor: Johnson Xuesong Shen
Automated and Real-time Scan-to-BIM through Deep Learning-based Object Detection

ZHANG, XIDONG
Supervisor: Adrian Russell
Assessing liquefaction susceptibility of fibre-reinforced sand.

SECTION 3

OUR RESEARCH

CIES RESEARCH HIGHLIGHTS

"Better than 100%"!

Creating a super-efficient mesh solver for high-performance computing





CIES Director Professor Chongmin Song and his team of researchers **Junqi Zhang**, **Ankit Ankit, Sascha Eisenträger**, and **Hauke Gravenkamp** (University of Duisburg-Essen, Germany) have created a super-efficient mesh solver for high-performance computing, with amazing results gained using the supercomputer Gadi at the National Computational Infrastructure (NCI), Australia's leading high-performance data, storage and computing organisation, located at ANU in Canberra.

NCI reported the work of the CIES team as one of their 2021 research highlights. According to the NCI, "in an unexpected and remarkable result, the computational method the UNSW team has developed actually achieves better than 100% efficiency."

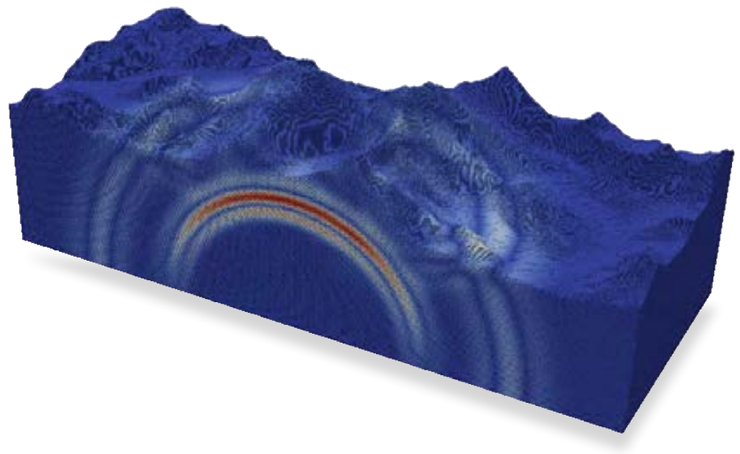
As NCI noted, the CIES research team also managed to achieve incredible scalability in their code.

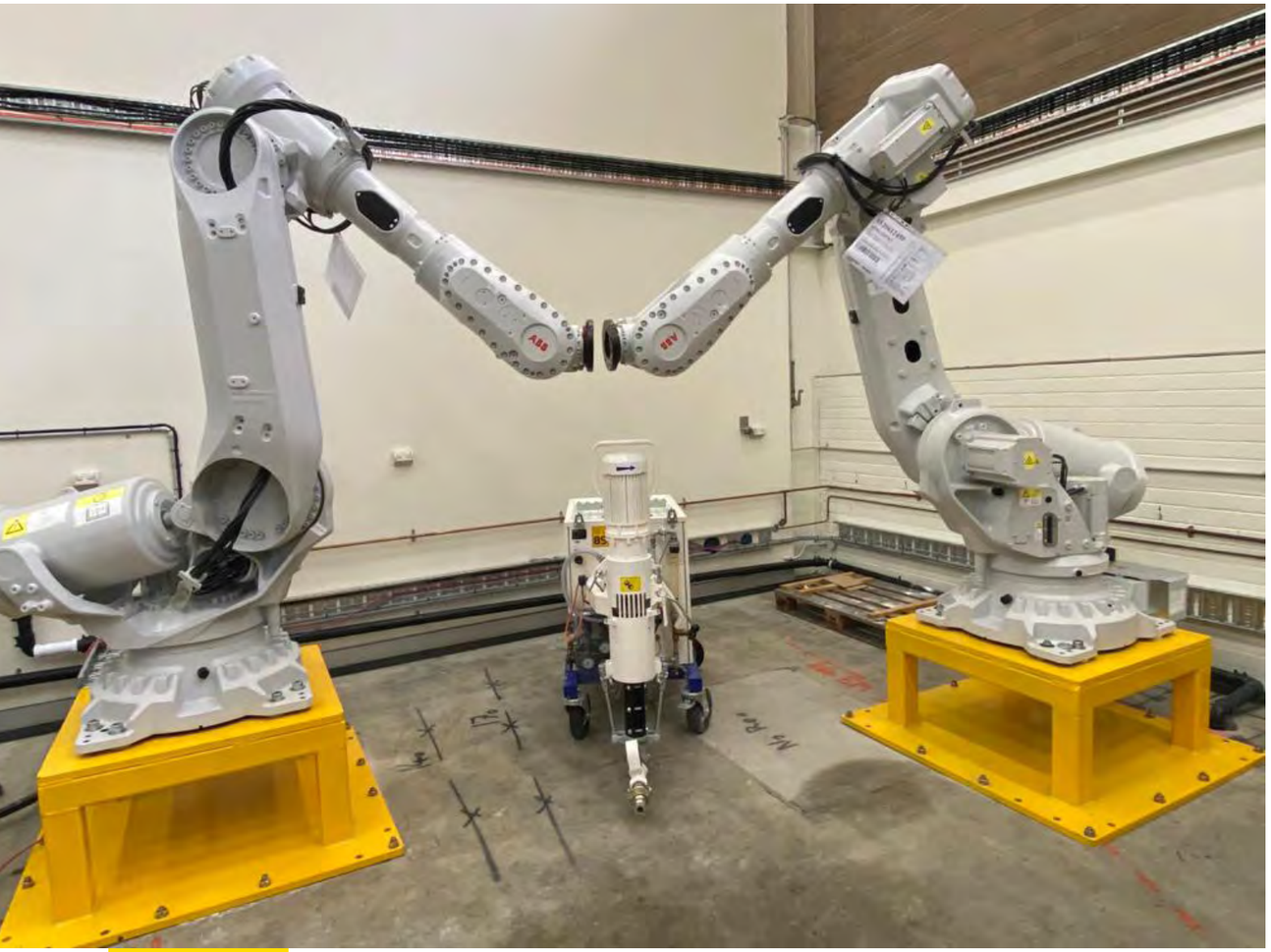
"There is a big potential," Professor Song says, "for future real world applications in earthquakes, crash simulations, construction, advanced manufacturing, and much more."

For more information see https://nci.org.au/research/research-highlights/creating-a-super-efficient-mesh-solver-high-performance-computing

The paper is at www.sciencedirect.com/science/article/abs/pii/S004578252100147X

"There is a big potential for furture real world applications..."





Above left: IDI research projects include decarbonising built environments with hempcrete and green wall technology (ARC Linkage).

Above right: IDI researchers are trialling a low carbon Geopolymer Concrete (GPC) containing recycled crushed glass as a replacement for virgin sand.

Dr Ali Kashani

INNOVATIVE DECARBONISED INFRASTRUCTURE (IDI)

Towards a low carbon economy for infrastructure

In 2021 CIES established an Innovative Decarbonised Infrastructure Initiative, (IDI) bringing together research experts in sustainability, decarbonisation, the circular economy, and climate-resilient infrastructure.

With its vision aligned with the NSW Government's Net Zero by 2050, IDI's aim is to help infrastructure and primary industries reduce their emissions utilising a wide variety of innovative ideas, materials, services and technologies.

This exciting new research initiative is being coordinated by CIES researcher Dr Ali Kashani, who believes industries and governments across the globe are dependent on innovative technologies to achieve their emissions reduction targets.

"This opportunity is welcomed by our researchers with strong research track record in low-carbon infrastructure, "he says, "and we have joined forces to make an impact through IDI."

Kashani who is a Lecturer in Sustainable Construction and Churchill Fellow in Construction Automation and 3D Printing has extensive experience in research, development, and commercialisation of advanced and sustainable construction materials.

The collective scientific and engineering expertise held within IDI is impressive, involving internationally recognised experts as well as emerging researchers – all passionate about finding solutions to the climate and resource challenges we now face.

IDI research strengths range from expertise in construction automation, decarbonised construction materials, sustainable hybrid structures, smart transport, resource recovery and waste utilisation, the principles of the circular economy and net-zero emission strategies.

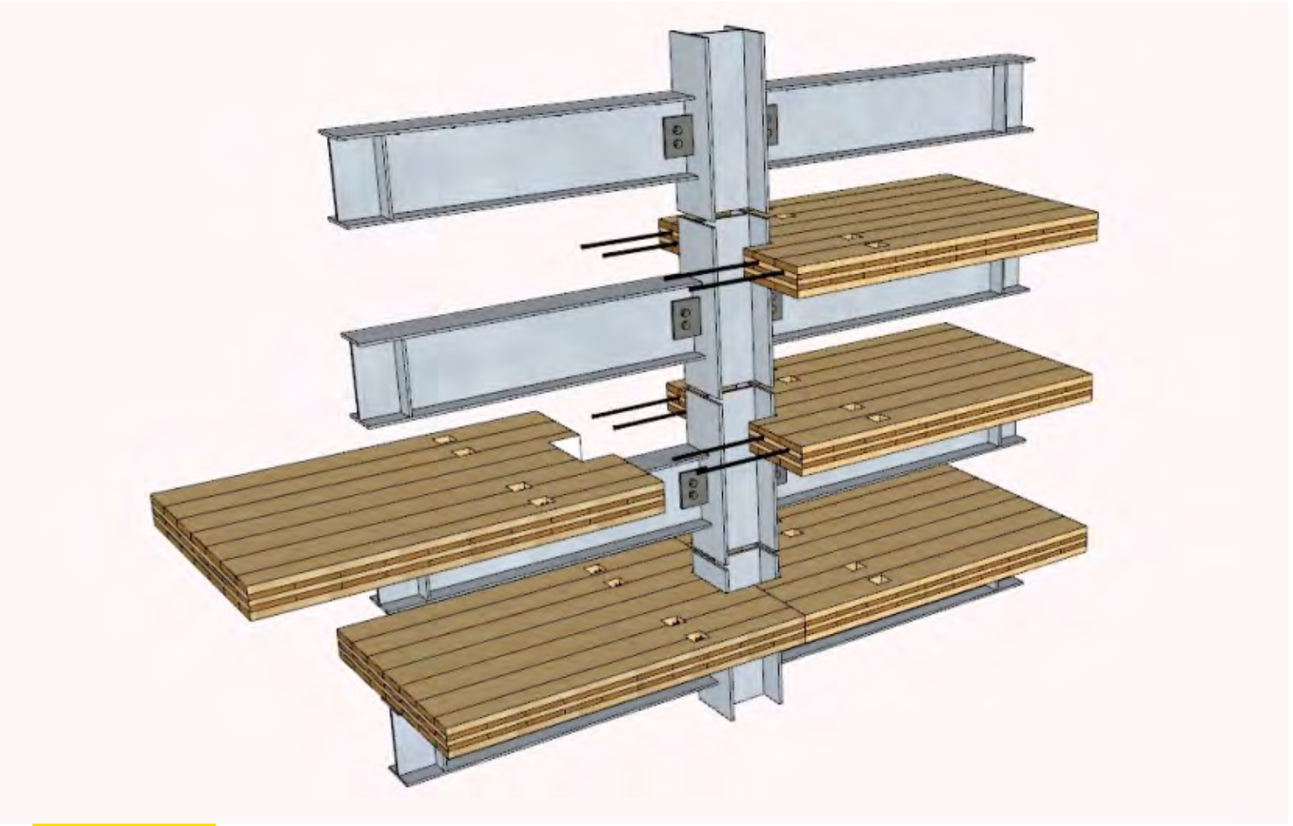
The work is backed by state-of-the-art research facilities and laboratories at UNSW Sydney and Canberra.

IDI researchers are already engaged in nineteen projects including next generation sustainable concrete, designing structures for end-of-life deconstructability, recycling plastic and paperboard waste into value-added asphalt additives, and conducting full international supply chain analysis to allow quantification of global origins and destinations of emissions.

"This opportunity is welcomed by our researchers with strong research track record in low-carbon infrastructure"

Dr Kashani says IDI provides a one-stop shop for the construction industry to benefit from UNSW's breadth and depth of knowledge and expertise in innovative low-carbon infrastructure, backed up by state-of-art facilities and laboratories. "We welcome collaboration with industry and the government towards our aim of decarbonised infrastructure by 2050."

For more information see https://www.cies.unsw.edu.au/innovative-decarbonised-infrastructure



Associate Professor Hamid Valipour

RESEARCH PROFILE: Hamid Valipour

CIES Associate Professor Hamid Valipour has long been a man on a mission- a mission to reduce the construction industry's currently massive carbon footprint. His work over the last ten years has focused on the development of innovative structural systems with lower energy and carbon footprints, which are easier to fabricate, assemble and dismantle than those of current practice.

Valipour's vision is for the widespread uptake of hybrid structural systems that fully exploit the advantages of steel, concrete and engineered timber to reduce the self-weight, cost and negative environmental impact of current structures, and also enhance opportunities for deconstruction, reusing and upgrading of structures.

And now it seems Dr Valipour's time might have come – after he won not one but TWO highly sought after and extremely competitive Australian Research Council Discovery Projects grants at the end of 2021.

One Discovery Project (DP) is on the topic of torsion in innovative timber composite floors, which have the potential to significantly improve the speed and efficiency and reduce the carbon and energy footprint of the construction industry.

Professor Stephen Foster

The second DP is in best practice connections for hybrid steel-timber-concrete structures. (See fuller details of Discovery Projects in Section One of this Report).

Hamid is Chief Investigator on both projects working with eminent CIES colleagues, Professor Mark Bradford for the topic of timber composite floors, and Professor Stephen Foster, Dean of UNSW Engineering, on connections. Both are global leaders in their respective fields – steel and concrete, while Valipour's expertise and research passion is timber.

It is timber which is the magic ingredient - which can transform the industry. Currently, buildings consist of reinforced concrete or steel-concrete composites, cast in situ. Cement is poured into formwork and propping is then required for at least a week. This is a wait of at least 10 days between storeys. Building with steel-timber composites (STCs) means there is no waiting and upward construction can be seamlessly ongoing.

Alongside no wait is less weight. Timber density is only 20% of concrete density. This reduces cranage and injury risk, and increases efficiency of moving, lifting and placing panels. Hybrid construction becomes realistic: building atop older structures diminishes the social disruption of demolition, reduces waste and increases construction adaptability.

Professor Mark Bradford

Hamid and his CIES colleague Laureate Professor Mark Bradford (chief investigators on DP160104092) have already demonstrated the feasibility and superior structural performance of innovative steel-timber systems compared to conventional steel-concrete composite. Hamid has also been busy developing, testing and numerically simulating hybrid/composite timber-concrete and steel-timber connections.

The innovative composite systems developed by Hamid and his research team can be easily dismantled at the end of building service life that will, in turn, significantly facilitate recycling, reusing and/or repurposing of the construction materials and hence reduce construction waste.

Hamid believes that as research and development continues, more buildings and designers will take advantage of innovative hybrid steel-timber-concrete systems. That they are the way of the future.

"It is timber which is the magic ingredient - which can transform the industry."

CIES RESEARCH GRANT INCOME 2021

CIES INVESTIGATORS	PROJECT TITLE	SPONSOR NAME	2021 AMOUNT
Bradford, MA	Vulnerability of Steel Lattice Towers to Fire	Australian Research Council | Discovery Project	102,067
Foster, SJ	Mixed Mode Torsion-Shear-Bending Failure in SFRC Elements	Australian Research Council | Discovery Project	130,000
Foster, SJ, Parvez, MA	Investigation into High Strength Steel Reinforcement for Australian Buildings and Infrastructure	InfraBuild Steel | Contract Research	40,909
Gao, W	Topological Design of Mechanical Meta-Structures	University of Technology, Sydney (UTS) | ARC Discovery Project Shared Grant	30,000
Gao, W	ARC Research Hub for nanoscience based construction material manufacturing (Project 1)	Monash University | ARC Industrial Transformation Research Hub Shared Grant	30,000
Gao, W	ARC Research Hub for Transformation of Reclaimed Waste Resources to Engineered Materials and Solutions for a Circular Economy	Royal Melbourne Institute of Technology | ARC Industrial Transformation Research Hub Shared Grant	60,000
Ge, L	SmartSat CRC PhD scholarship for Chang Liu	CRC for SmartSat | PhD Scholarship	14,583
Gilbert, RI	Time Dependent Behaviour of Fibre Reinforced Concrete Structures.	Australian Research Council | Discovery Project	140,000
Gilbert, RI	Shrinkage, cracking, self-healing and corrosion in blended cement concrete	University of Technology, Sydney (UTS) | ARC Linkage Project Shared Grant	28,250
Hajimohammadi, A Kim, T	Investigating the reuse of glass from waste photovoltaic modules for construction applications	E3Sixty Solar | NSW EPA Circular Solar Trials Grants Program Shared Grant	89,820
Hajimohammadi, A Kim, T, Foster, SJ	Next generation sustainable concrete: trialling recycled glass in geopolymer concretes	John Holland Pty Ltd | NSW EPA Civil Construction Market Program Shared Grant	62,497
Kashani, A	Developing a mortar for 3D printing using a gantry system	Contour 3d Pty Ltd | Contract Research	10,302
Kashani, A, Kim, T, Foster, SJ	Development of Sustainable Concrete with Glass Waste Mixes	XL Precast Pty Ltd | Innovation Connections Contract	18,689
Khalili-Naghadeh, N Hajimohammadi, A Shahbodaghkhan, B	Recycling plastic and paperboard waste to develop value-added asphalt	State Asphalts NSW Pty Ltd | DIIS - Cooperative Research Centre Projects (CRC-P's) Shared Grant	470,625
Khalili-Naghadeh, N Khoshghalb, A	Non-isothermal dynamic strain localisation in unsaturated porous media	Australian Research Council | Discovery Project	100,000
Khalili-Naghadeh, N Russell, A	Modelling creep and time-dependency in unsaturated soils	Australian Research Council | Discovery Project	115,000
Khalili-Naghadeh, N Russell, A	Experimental investigation and constitutive modelling of reactive soils	Australian Research Council | Linkage Project | PSM Consult Pty Ltd | Dept Planning, Transport & Infrastructure (SA)	173,259
Khalili-Naghadeh, N Shen, X Shahbodaghkhan, B Vahab, M	ARC Industry Transformation Research Hub for Resilient and Intelligent Infrastructure Systems (RIIS) in Urban, Resources and Energy Sectors	Australian Research Council | Industrial Transformation Research Hubs	996,000
Kim, T Hajimohammadi, A	Decarbonising built environments with hempcrete and green wall technology	University of Technology, Sydney (UTS) | ARC Linkage Project Shared Grant	7,000
Makki Alamdari, M	Developing an Advanced Drive-by Bridge Inspection Technology	Australian Research Council | Discovery Early Career Researcher Award (DECRA)	130,832
Regenauer-Lieb, K Halim,A, Foster, SJ Daniels, JE, Ferry, M	A 4-D X-Ray Microscopy Laboratory	Australian Research Council | LIEF/ with U Syd, QUT, UQ	256,000
Russell, A	Preventing mining disasters: reducing the risk of tailings dam failure	Australian Research Council | Future Fellowship	216,666
Russell, A	Tailings Dams - Methods to incorporate suction into data interpretation and stability assessment	BHP Billiton Olympic Dam Corporation Pty Ltd | Contract Research	50,000
Russell, A	Geotechnical testing of a soil with Chembase added to improve properties - Round 2	Chembase International Pty Ltd | Contract Research	59,100
Song, C	Computational fracture analysis of structures and materials	Australian Research Council | Discovery Project	140,000
Song, C	Ship response under corrosion, fatigue and complex sea-state environments	University of Newcastle | ARC Linkage Project Shared Grant/ Pacific ESI / DSTG	95,592
Vali Pour Goudarzi, HR	Method maturity test on UHPFRC/UHPC	Sydney Trains | State Government Contract	6,050
Vali Pour Goudarzi, HR	Uniaxial static and cyclic(fatigue) compression tests on standard cylinders.	Wagners EFC Pty Ltd | Contract Research	20,846
Vali Pour Goudarzi, HR	Timber-steel joint tests and modelling	Viridi Group Private Limited | Contract Research	9,684
Zhao, XL	Structural assembly for remote housing using fibre reinforced composites	Monash University | ARC Linkage Project Shared Grant	8,000
TOTAL			**3,611,771.00**

CIES LABORATORIES EQUIPMENT AND CAPABILITIES

Our laboratories

CIES research and commercial activities are conducted within extensive physical laboratory resources, with a wide variety of equipment. These state-of-the-art facilities enable us to undertake our cutting-edge research, and thorough and timely industry investigations.

Our Cementitious Materials Laboratory is equipped with cutting-edge facilities for measuring cement and concrete materials characterisation and for durability testing. This includes: Thermogravimetric Analysis (TGA); isothermal calorimeter; laser Flash analyser; Plasma CVD equipment; eleven channels potentiostat for standard steel reinforcement corrosion testing; accelerated carbonation chamber; sorption-desorption testing apparatus and more.

Our Construction Automation Laboratory: This new research facility will be used to fundamentally research, develop, refine, and systematically evaluate automated construction techniques for increased collaboration with industry, leading to rapid technology transfer. The state-of-the-art research facility will enable new methods of digital 3D printing by addressing the reinforcement issue and other main challenges of construction 3D printing.

It can also be used for cross-disciplinary projects by UNSW researchers, the construction industry and other researchers around the world.

CIES can play an important role in construction automation not only in Australia but also internationally by fulfilling the need for a research facility to implement collaborative robots for construction activities. This research facility will be used for other construction automation processes including modular construction and structural assembly, shotcreting, BIM integration, automated demolition, and automated bricklaying. It can also be used for cross-disciplinary projects by UNSW researchers, the construction industry and other researchers around the world.

Our Geotechnical Engineering Laboratories: The scale of capability for geotechnical engineering research and testing is not available in any other university in Australia. Importantly, triplicates (or more) of the most highly used equipment (triaxials and oedometer/CRS frames) are available enabling an ambitious program of experiments to be completed in a timely manner.

Our Heavy Structures Laboratories are equipped with state-of-the-art servo-controlled hydraulic actuators and universal testing machines to maintain a capacity for high load testing, ranging from 10 kN to 5000 kN. We combine strength testing with X-Ray measuring of laboratory specimens under load. This improves understanding at the materials level for the development of refined, mechanically based, structural models.

CIES Testing Capability for Construction Materials

CIES laboratories are well equipped to conduct any type of experiment related to construction materials.

1. MATERIALS

- Concrete (from conventional Portland cement-based concrete to alternative concrete, including 3D printable concrete)
- Asphalt
- Timber
- Any components of construction materials including Portland cement, aggregates, supplementary cementitious materials, emulsion, industrial by-wastes, etc.
- Development of the optimum mixture design and the sustainable mixture design

2. MECHANICAL TESTS

- Setting time, slump, rheological properties
- All types of strength tests
- Creep tests
- Shrinkage tests (chemical, autogenous, and drying shrinkages)
- Thermal cracking tests
- Restrained shrinkage cracking tests

3. DURABILITY TESTS

- Various chemical attacks (acid attack, sulfate attack, and chloride attack)
- Corrosion potential tests
- Chloride diffusion tests
- Alkali-silica reaction
- Carbonation
- Water absorption

4. CHARACTERISATION OF MATERIALS

- Elemental composition and mineralogical composition of materials
- Materials reactivity as construction materials
- Thermal properties of materials
- Electrical properties
- Microstructure changes
- Pore structural changes

CIES Equipment for Construction Materials Testing

1.1 MECHANICAL PROPERTIES

- Strength testing machines
  - Avery 1800kN Concrete Compression testing machine
  - Satec 3Mn Static compression testing machine
  - INSTRON 10kN Universal testing machine
- Different sizes of mixers
- Flow table tests
- VICAMATIC-20UTCM (Automatic Vicat apparatus for setting time)
- Discovery Hybrid Rheometer – 2 for the rheological properties
- Shrinkage and creep testing apparatus
- Corrugated autogenous shrinkage apparatus (in compliance with ASTM C1698)
  - Apparatus for chemical shrinkage (in compliance with ASTM C1608)
  - Concrete prism drying shrinkage
  - Compressive creep test
  - Tensile creep test
- Rigid cracking frame for thermal cracking of the concrete
- 3D printing robotic arms

1.2 DURABILITY TESTS

- Corrosion tests
  - Chloride bulk diffusion test
  - Rapid chloride penetration test
  - Rapid chloride migration test
  - Robotic titrosampler analysis of the chloride profile in concrete
  - Potentiometer for the corrosion potential measurement (VMP3-01/Z DC +EIC channels)
- Environmental control chambers (humidity and temperature)
- Carbonation chamber
- Glove boxes to control the environments

1.3 CHARACTERISATION OF MATERIALS

- Thermogravimetric analysis (Q600-SDT simultaneous SDC-TGA)
- Thermal diffusivity measurement (LFA-3467 Hyperflaseh)
- Thermal conductivity (Trident C-therm)
- Adsorption and desorption analyzer for pore size distribution and surface area (NOVAtouch NT 4LX)
- Ball mill grinder (Fritsch Pulverisette-6 Mill)
- Mercury Introsion Porosmetry (Micromeritics autopore 9520)
- Ultrasonic pulse velocity measurement (Pundit PL200 Ultrasonic tester)
- Surface electrical resistivity measurement (Proceq concrete resistivity meter)
- Particle size distribution analyzer (Malvern Mastersizer)
- Fourier transformation infrared (FTIR) spectroscopy (PerkinElmer FTIR)
- Concrete pore solution analysis (Pore solution extraction device and Inductively coupled plasma – optical emission spectroscopy)

4. ALL OTHER ANALYTICAL CHARACTERISATION TECHNIQUES ARE AVAILABLE IN MARK WAINWRIGHT ANALYTICAL CENTRE AT UNSW

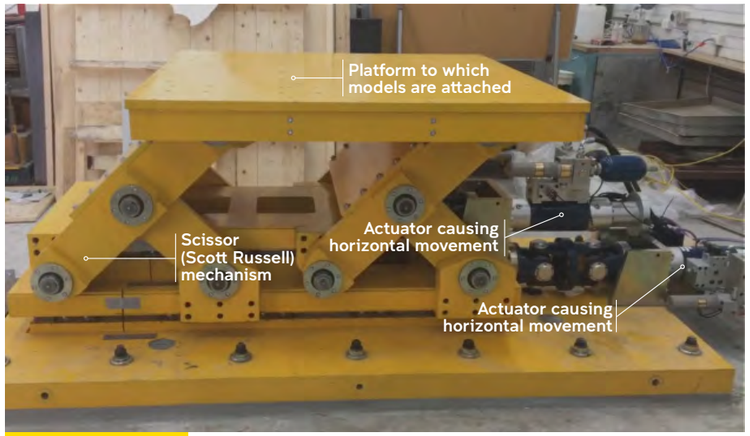
- Scanning electron microscopy – Energy dispersive spectroscopy
- X-ray fluorescence (XRF)
- X-ray diffraction (XRD) facility
- Tyree X-ray CT facility
- Nuclear magnetic resonance (NMR) facility

CIES Geotechnical Engineering Laboratories

Our well-equipped geotechnical engineering laboratories contain a diverse range of soil, rock and asphalt testing equipment, along with specialist and advanced equipment used to support industry-focused research. Our researchers are award-winning and recognised globally as leaders in their field. The scale of our laboratory capability is not available in any other university in Australia.

EQUIPMENT INCLUDES:

- Earthquake shaking table (permitting simultaneous horizontal and vertical motion) and laminated shear stack – 2.6 tonne models http://www.cies.unsw.edu.au/news/earthquake-research-given-a-shake-up
- Calibration chamber for CPT testing (adaptable for pile testing, pressuremeter testing and dilatometertesting) https://www.linkedin.com/feed/update/activity:6422264686678540288/
- 2cm2 cone, Hyson 100kN penetrometer, logging system and calibration chamber for housing large unsaturated soil and tailings samples
- Enterprise level dynamic triaxial testing facility for saturated and unsaturated samples (x2)
- Enterprise level dynamic simple shear testing facility for saturated and unsaturated samples (x1)
- Enterprise level dynamic true triaxial testing facility for saturated and unsaturated samples (x1)
- Consolidometers (CRS and standard) (for testing saturated and unsaturated samples 50100mm diameter) (x 4)
- Slurriometer (for testing saturated and very soft (tailings like) deposits, 50mm diameter) (x 1)
- Resonant column testing facilities for saturated and unsaturated samples (x2)
- Rock triaxial cell for testing samples 25mm, 50mm or 100mm diameter at cell pressures up to 64MPa (x1)
- Bishop Wesley triaxial equipment for testing saturated and unsaturated soils (x 4, including one for testing at elevated temperatures)
- Triaxial cells for saturated soil samples 100mm and 200mm diameters (x 2)
- Standard triaxial cell for testing saturated samples of 50mm diameter (x1)
- Ring shear equipment for assessing residual strength within soil and at interfaces (Bromhead type) (x1)
- Shear boxes (for testing samples 100mm by 100mm) (x 4)
- Large shear box (for testing samples 300mm by 300mm) (x1)
- Lysimeter lights and frames to simulate sun drying
- Lateral earth pressure rig – 3 tonne models
- Shallow foundation testing rig – 2 tonne models
- Soil pressure plates for determining relationship between suction and moisture content (x4)
- Osmotic equipment for determining relationship between suction and moisture content
- Filter paper equipment for determining relationship between suction and moisture content
- Bespoke soil erosion testing equipment (pinhole erosion, suffusion, internal erosion and surface erosion)



Inventory of Major Testing Facilities at Heavy Structures Lab

- A RED Testing Frame with INSTRON 5 MN Compression/Tension actuator for static or low frequency dynamic tests
- A YELLOW Testing Frame with two INSTRON 500 kN Compression/Tension actuators for individual or collaborative static or dynamic/fatigue tests
- A GREEN Testing Frame with one INSTRON 1.2 MN Compression/Tension actuator and one INSTRON 300 kN HORIZONTAL Compression/Tension actuator for individual static or dynamic/fatigue tests
- 1 MN INSTRON Tension/Compression Universal testing machine for static or dynamic/fatigue tests
- 250 kN INSTRON Tension/Compression Universal testing machine for static or dynamic/fatigue tests
- 2 MN INSTRON testing machine for static Compression tests
- A Steel Frame (Gray) with a 2.5 MN compression ram for long term loading tests
- A Steel Frame (Blue) with a 2 MN compression ram for long term loading tests
- A 29.3 x 9.75 x1.22m prestressed reinforced concrete floor area provided a strong structural footing for 3 major testing frames (Red, Yellow and Green) plus quite a few anchor points for setting up small steel frames for short/long term loading tests
- A climate (Temperature and R/H) controlled room with 6+ creep rigs for creep testing
- A 5t overhead bridge crane, a 10m vertical mast Elevated Work Platform (EWP), 2 forklifts (2.5t and 1.5t) and a battery Walkie (1.3t) enabled mobile handling and setting up/disposal of large and heavy specimens
- A VIC-3D DIC (Digital Image Correlation) system enables advanced 2D and 3D strain measurements of specimens during experimental testing

CIES PUBLICATIONS 2021

APA6 Citation. CIES Author/s in bold

In 2021 CIES researchers published 144 refereed journal papers, nine book chapters and one book.

BOOK

Foster S.J., Kilpatrick A.E. and Warner R.F., "Reinforced Concrete Basics: Analysis and design of reinforced concrete structures", 3rd Ed., Pearson, 2021, 615 pp. ISBN: 9780655703679.

BOOK CHAPTER

Kashani, A. (2021). Influence of precursors on rheology of alkali-activated materials. In Handbook of advances in Alkali-activated Concrete. Woodhead Publishing newly inserted

Geng, Y., Ranzi, G., Wang, Y. -Y., **Gilbert, R. I**., & Zhang, S. (2021). State-of-the-art review on the time-dependent behaviour of composite steel-concrete columns. In Time-dependent behaviour and design of composite steel-concrete structures (pp. 83-109). International Association for Bridge and Structural Engineering (IABSE). doi:10.2749/sed018.ch5

Pérez Caldentey, A., Dezi, L., Jordán, J., Leoni, G., Ranzi, G., & **Gilbert, R. I**. (2021). Case studies considering the influence of the time-dependent behaviour of concrete on the serviceability limit state design of composite steel-concrete bridges. In Time-dependent behaviour and design of composite steel-concrete structures (pp. 157-188). International Association for Bridge and Structural Engineering (IABSE). doi:10.2749/sed018.ch8

Pérez Caldentey, A., Hewitt, J., van Rooyen, J., Leoni, G., Ranzi, G., & **Gilbert, R. I.** (2021). Case studies considering the influence of the time-dependent behaviour of concrete on the serviceability limit state design of composite steel-concrete buildings. In Time-dependent behaviour and design of composite steel-concrete structures (pp. 137-156). International Association for Bridge and Structural Engineering (IABSE). doi:10.2749/sed018.ch7

Ranzi, G., & **Gilbert, R. I.** (2021). State-of-the-art review on the time-dependent behaviour of composite steel-concrete slabs. In Time-dependent behaviour and design of composite steel-concrete structures (pp. 41-59). International Association for Bridge and Structural Engineering (IABSE). doi:10.2749/sed018.ch3

Ranzi, G., Di Luzio, G., Bocciarelli, M., Leoni, G., Dönmez, A. A., Cusatis, G., . . . **Gilbert, R. I.** (2021). Time-dependent behaviour of concrete. In Time-dependent behaviour and design of composite steel-concrete structures (pp. 13-40). International Association for Bridge and Structural Engineering (IABSE). doi:10.2749/sed018.ch2

Ranzi, G., **Gilbert, R. I.**, Leoni, G., Dezi, L., Pérez Caldentey, A., Jordán, J., . . . Rauch, M. (2021). Introduction. In Time-dependent behaviour and design of composite steel-concrete structures (pp. 1-12). International Association for Bridge and Structural Engineering (IABSE). doi:10.2749/sed018.ch1

Ranzi, G., Leoni, G., Dezi, L., Pérez Caldentey, A., Hewitt, J., Jordán, J., **Gilbert, RI** . . . Rauch, M. (2021). Design specifications for the time-dependent behaviour of composite steel-concrete structures. In Time-dependent behaviour and design of composite steel-concrete structures (pp. 111-136). International Association for Bridge and Structural Engineering (IABSE). doi:10.2749/sed018.ch6

Ranzi, G., Leoni, G., **Gilbert, R. I**., Dezi, L., & Zandonini, R. (2021). State-of-the-art review on the time-dependent behaviour of composite steel-concrete beams. In Time-dependent behaviour and design of composite steel-concrete structures (pp. 61-82). International Association for Bridge and Structural Engineering (IABSE). doi:10.2749/sed018.ch4

JOURNAL ARTICLE

Agarwal, A., **Foster, S.J.** and Stewart, M.G., Model error and reliability of RC beams in shear designed according to the modified compression field theory, Structural Concrete, Vol. 22, Issue 6, 2021, pp. 3711-3726.

Al-Mosawe, A., Al-Mahaidi, R., Alwash, D., & **Zhao, X. L.** (2021). Finite element simulation of unbonded retrofitting system for a steel bridge in Australia. Australian Journal of Structural Engineering, 22(1), 29-41. doi:10.1080/13287982.2021.1872992

Alnahhal, M. F., Hamdan, A., Hajimohammadi, A., & **Kim, T.** (2021). Effect of rice husk ash-derived activator on the structural build-up of alkali activated materials. Cement and Concrete Research, 150. doi:10.1016/j.cemconres.2021.106590

Alnahhal, M. F., Kim, T., & **Hajimohammadi, A.** (2021). Distinctive rheological and temporal viscoelastic behaviour of alkali-activated fly ash/slag pastes: A comparative study with cement paste. Cement and Concrete Research, 144. doi:10.1016/j.cemconres.2021.106441

Alnahhal, M. F., Kim, T., & **Hajimohammadi, A.** (2021). Waste-derived activators for alkali-activated materials: A review. Cement and Concrete Composites, 118. doi:10.1016/j.cemconcomp.2021.103980

Amraei, M., Jiao, H., Toghyani, A., Björk, T., & **Zhao, X. L.** (2021). CFRP strengthening of butt-welded ultra-high strength steels under quasi-static tensile loading. Engineering Structures, 246. doi:10.1016/j.engstruct.2021.113052

Bazli, M., **Zhao, X. L.**, Jafari, A., Ashrafi, H., Raman, R. S., Bai, Y., & Khezrzadeh, H. (2021). Durability of glass-fibre-reinforced polymer composites under seawater and sea-sand concrete coupled with harsh outdoor environments. Advances in Structural Engineering, 24(6), 1090-1109. doi:10.1177/1369433220947897

Bidarmaghz, A., Choudhary, R., Narsilio, G., & Soga, K. (2021). Impacts of underground climate change on urban geothermal potential: Lessons learnt from a case study in London. Science of the Total Environment, 778. doi:10.1016/j.scitotenv.2021.146196

Bidarmaghz, A., Makasis, N., Fei, W., & Narsilio, G. A. (2021). An efficient and sustainable approach for cooling underground substations. Tunnelling and Underground Space Technology, 113. doi:10.1016/j.tust.2021.103986

Birk, C., Lupascu, D. C., Vadalaà, M., & **Saputra, A.** (2021). Image-based stress analysis of porous freeze casts. PAMM, 20(1). doi:10.1002/pamm.202000135

Borrie, D., Al-saadi, S., **Zhao, X. L.**, Singh Raman, R. K., & Bai, Y. (2021). Bonded cfrp/steel systems, remedies of bond degradation and behaviour of CFRP repaired steel: An overview. Polymers, 13(9). doi:10.3390/polym13091533

Borrie, D., Al-Saadi, S., **Zhao, X. L.**, Singh Raman, R. K., & Bai, Y. (2021). Effects of CNT modified adhesives and silane chemical pre-treatment on CFRP/steel bond behaviour and durability. Construction and Building Materials, 273. doi:10.1016/j.conbuildmat.2020.121803

Carmichael, D. G. (2021). At one with systems. Civil Engineering and Environmental Systems, 38(4), 265-268. doi:10.1080/10286608.2021.1980542

Carmichael, D. G. (2021). Author's reply to: David Elms' discussion of 'a framework for a civil engineering BOK'. Civil Engineering and Environmental Systems, 38(4), 276-278. doi:10.1080/10286608.2021.1980549

Carmichael, D. G. (2021). Author's reply to: David Blockley's discussion of the special issue. Civil Engineering and Environmental Systems, 38(4), 250. doi:10.1080/10286608.2021.1980550

Carmichael, D. G. (2021). BOK and terminology. Civil Engineering and Environmental Systems, 38(4), 257-258. doi:10.1080/10286608.2021.1980543

Cheema, P., Alamdari, **Makki Alamdari, M.**, Vio, G. A., Zhang, F. L., & Kim, C. W. (2021). Infinite mixture models for operational modal analysis: An automated and principled approach. Journal of Sound and Vibration, 491. doi:10.1016/j.jsv.2020.115757

Chen, J., Hamed, E., & **Gilbert, R. I.** (2021). Structural performance of concrete sandwich panels under fire. Fire Safety Journal, 121. doi:10.1016/j.firesaf.2021.103293

Chen, X., Chang-Richards, A. Y., Pelosi, A., Jia, Y., **Shen, X.**, Siddiqui, M. K., & Yang, N. (2021). Implementation of technologies in the construction industry: a systematic review. Engineering, Construction and Architectural Management. doi:10.1108/ECAM-02-2021-0172

Chen, Y., Wu, D., Yu, Y., & **Gao, W.** (2021). An improved theory in the determination of aerodynamic damping for a horizontal axis wind turbine (HAWT). Journal of Wind Engineering and Industrial Aerodynamics, 213. doi:10.1016/j.jweia.2021.104619

Chen, Y., Wu, D., Yu, Y., & **Gao, W.** (2021). Do cyclone impacts really matter for the long-term performance of an offshore wind turbine?. Renewable Energy, 178, 184-201. doi:10.1016/j.renene.2021.06.044

Cheng, J., Lu, W., Liu, Z., Wu, D., **Gao, W.**, & Tan, J. (2021). Robust optimization of engineering structures involving hybrid probabilistic and interval uncertainties. Structural and Multidisciplinary Optimization, 63(3), 1327-1349. doi:10.1007/s00158-020-02762-6

Chiniforush, A. A., Ataei, A., & **Bradford, M. A.** (2021). Experimental study of deconstructable bolt shear connectors subjected to cyclic loading. Journal of Constructional Steel Research, 183. doi:10.1016/j.jcsr.2021.106741

Chiniforush, A. A., Gharehchaei, M., Akbar Nezhad, A., Castel, A., Moghaddam, F., Keyte, L., . . . **Foster, S.** (2021). Minimising risk of early-age thermal cracking and delayed ettringite formation in concrete – A hybrid numerical simulation and genetic algorithm mix optimisation approach. Construction and Building Materials, 299. doi:10.1016/j.conbuildmat.2021.124280

Chiniforush, A. A., Valipour, H. R., & **Akbarnezhad, A.** (2021). Long-term coupled analysis of steel-timber composite (STC) beams. Construction and Building Materials, 278. doi:10.1016/j.conbuildmat.2021.122348

Chiniforush, A. A., Valipour, H. R., & Ataei, A. (2021). Timber-timber composite (TTC) connections and beams: An experimental and numerical study. Construction and Building Materials, 303. doi:10.1016/j.conbuildmat.2021.124493

Chiniforush, A. A., Valipour, H. R., Bradford, M. A., & Akbar Nezhad, A. (2021). Experimental and theoretical investigation of long-term performance of steel-timber composite beams. Engineering Structures, 249. doi:10.1016/j.engstruct.2021.113314

Dong, Z., Sun, Y., Wu, G., Zhu, H., **Zhao, X. L.**, Wei, Y., & Zhang, P. (2021). Flexural behavior of seawater sea-sand concrete beams reinforced with BFRP bars/grids and BFRP-wrapped steel tubes. Composite Structures, 268. doi:10.1016/j.compstruct.2021.113956

Dong, Z., Wu, G., Zhu, H., Wei, Y., **Zhao, X. L.**, & Shao, X. (2021). Bond and flexural performance of basalt fiber–reinforced polymer bar–reinforced seawater sea sand glass aggregate concrete beams. Advances in Structural Engineering, 24(15), 3359-3374. doi:10.1177/13694332211026228

Dsouza, S. M., Pramod, A. L. N., Ooi, E. T., **Song, C.**, & Natarajan, S. (2021). Robust modelling of implicit interfaces by the scaled boundary finite element method. Engineering Analysis with Boundary Elements, 124, 266-286. doi:10.1016/j.enganabound.2020.12.025

Eisenträger, J., Zhang, J., & **Song, C**. (2021). A Scaled Boundary Approach for Inelasticity of Fibre-Reinforced Composites. PAMM, 20(1). doi:10.1002/pamm.202000108

Eisenträger, S., Eisenträger, J., Gravenkamp, H., & Provatidis, C. G. (2021). High order transition elements: The xNy-element concept, Part II: Dynamics. Computer Methods in Applied Mechanics and Engineering, 387. doi:10.1016/j.cma.2021.114145

Farmani, M. A., Heidarpour, A., & **Zhao, X. L.** (2021). A distinctive approach to testing and modeling thermal creep in ultra-high strength steel. International Journal of Mechanical Sciences, 198. doi:10.1016/j.ijmecsci.2021.106362

Feng, Y., Wang, Q., Wu, D., Luo, Z., **Chen, X.**, Zhang, T., & **Gao, W.** (2021). Machine learning aided phase field method for fracture mechanics. International Journal of Engineering Science, 169. doi:10.1016/j.ijengsci.2021.103587

Fu, J., Bligh, M. W., Shikhov, I., Jones, A. M., Holt, C., Keyte, L. M., **Foster, S.J.**, Waite, T. D. (2021). A microstructural investigation of a Na2SO4 activated cement-slag blend. Cement and Concrete Research, 150. doi:10.1016/j.cemconres.2021.106609

Garg, N., **Saputra, A.**, Donough, M., **Song, C.**, Phillips, A. W., & Prusty, B. G. (2021). Application of scaled boundary finite element method for three-dimensional modeling of bi-axial bending in thick laminated composite plates. Mechanics of Advanced Materials and Structures. doi:10.1080/15376494.2021.1989526

Gluege, R., Altenbach, H., & **Eisentrager, S.** (2021). Locally-synchronous, iterative solver for Fourier-based homogenization. COMPUTATIONAL MECHANICS, 68(3), 599-618. doi:10.1007/s00466-021-01975-w

Gravenkamp, H., **Saputra, A. A.**, & **Eisenträger, S.** (2021). Efficient modeling of 3D geometries using octree-meshes combined with SBFEM and transfinite elements. PAMM, 20(1). doi:10.1002/pamm.202000226

Gravenkamp, H., **Saputra, A. A., Eisentraeger, S** & Duczek, S. (2021). High-Order Shape Functions in the Scaled Boundary Finite Element Method Revisited. Archives of Computational Methods in Engineering, 28(2), 473-494. doi:10.1007/s11831-019-09385-1

Gupta, S., & **Kashani, A.** (2021). Utilization of biochar from unwashed peanut shell in cementitious building materials – Effect on early age properties and environmental benefits. Fuel Processing Technology, 218. doi:10.1016/j.fuproc.2021.106841

Gupta, S., **Kashani, A., Mahmood, A. H.,** & Han, T. (2021). Carbon sequestration in cementitious composites using biochar and fly ash – Effect on mechanical and durability properties. Construction and Building Materials, 291. doi:10.1016/j.conbuildmat.2021.123363

Hadsari, V., & **Russell, A. R.** (2021). Pore-size evolution of a hydraulically deposited silty sand due to drying and rewetting. Geotechnique Letters, 11(3), 187-194. doi:10.1680/jgele.20.00147

Hashemi, S. K., **Valipour, H. R.,** & **Bradford, M. A.** (2021). Effect of the Traffic Load Distribution on the Progressive Collapse of a Cable-Stayed Bridge Under Blast Load. International Journal of Steel Structures, 21(6), 1937-1952. doi:10.1007/s13296-021-00544-4

He, K., **Song, C.,** & **Fell, R.** (2021). Numerical modelling of transverse cracking in embankment dams. Computers and Geotechnics, 132. doi:10.1016/j.compgeo.2021.104028

Heydari, S., **Hajimohammadi, A.,** Haji Seyed Javadi, N., & **Khalili, N.** (2021). The use of plastic waste in asphalt: A critical review on asphalt mix design and Marshall properties. Construction and Building Materials, 309. doi:10.1016/j.conbuildmat.2021.125185

Hirmand, M. R., **Vahab, M.**, Papoulia, K. D., & **Khalili, N.** (2021). Energy minimization versus criteria-based methods in discrete cohesive fracture simulations. Computational Mechanics, 68(4), 845-860. doi:10.1007/s00466-021-02049-7w

Hirshikesh., Pramod, A. L. N., Ooi, E. T., **Song, C.**, & Natarajan, S. (2021). An adaptive scaled boundary finite element method for contact analysis. European Journal of Mechanics, A/Solids, 86. doi:10.1016/j.euromechsol.2020.104180

Honeycutt, W. T., **Kim, T.**, Ley, M. T., & Materer, N. F. (2021). Sensor array for wireless remote monitoring of carbon dioxide and methane near carbon sequestration and oil recovery sites. RSC Advances, 11(12), 6972-6984. doi:10.1039/d0ra08593f

Jafari, A., Vahab, M., & **Khalili, N.** (2021). Fully coupled XFEM formulation for hydraulic fracturing simulation based on a generalized fluid leak-off model. Computer Methods in Applied Mechanics and Engineering, 373. doi:10.1016/j.cma.2020.113447

Jeong, D. J., **Kim, T.**, Ryu, J. H., & Kim, J. H. (2021). Analytical model to parameterize the adiabatic temperature rise of concrete. Construction and Building Materials, 268. doi:10.1016/j.conbuildmat.2020.121656

Jiang, J., & **Chen, X.** (n.d.). Pure characteristics demand models and distributionally robust mathematical programs with stochastic complementarity constraints. Mathematical Programming. doi:10.1007/s10107-021-01720-4

Karimi-Nobandegani, A., & **Valipour, H.** (2021). Timber beams with openings: Laboratory testing and nonlocal finite element modelling. Engineering Structures, 245. doi:10.1016/j.engstruct.2021.112867

Karunarathna, S., Linforth, S., **Kashani, A.**, Liu, X., & Ngo, T. (2021). Effect of recycled rubber aggregate size on fracture and other mechanical properties of structural concrete. Journal of Cleaner Production, 314. doi:10.1016/j.jclepro.2021.128230

Kellermann, D. C., **Attard, M. M.,** & **O'Shea, D. J.** (2021). Fourth-order tensor algebraic operations and matrix representation in continuum mechanics. Archive of Applied Mechanics, 91(12), 4631-4668. doi:10.1007/s00419-021-01926-0

Khajah, T., Liu, L., **Song, C.**, & Gravenkamp, H. (2021). Shape optimization of acoustic devices using the Scaled Boundary Finite Element Method. Wave Motion, 104. doi:10.1016/j.wavemoti.2021.102732

Khalajestani, M. K., Parvez, A., Foster, S. J., Valipour, H., & McGregor, G. (2021). Concentrically and eccentrically loaded high-strength concrete columns with high-strength reinforcement: An experimental study. Engineering Structures, 248. doi:10.1016/j.engstruct.2021.113251

Khoshghalb, A., & Shafee, A. (2021). Does the upper bound solution property of the Node-based Smoothed Point Interpolation Methods (NSPIMs) hold true in coupled flow-deformation problems of porous media?. Computers and Geotechnics, 133. doi:10.1016/j.compgeo.2021.104016

Khoshghalb, A., Nobarinia, M., Stockton, J., & Kalateh, F. (2021). On the effect of compaction on the progression of concentrated leaks in cohesive soils. Acta Geotechnica, 16(5), 1635-1645. doi:10.1007/s11440-020-01029-0

Kia, L., & **Valipour, H. R.** (2021). Composite timber-steel encased columns subjected to concentric loading. Engineering Structures, 232. doi:10.1016/j.engstruct.2020.111825

Kildashti, K., Samali, B., Malik, A., & Alamdari, **Makki Alamdari, M.** (2021). Computational simulation of eccentrically loaded reinforced concrete walls formed with modular thin-walled permanent formwork system. Journal of Building Engineering, 36. doi:10.1016/j.jobe.2020.102131

Li, C., & **Chen, X.** (n.d.). Isotropic non-Lipschitz regularization for sparse representations of random fields on the sphere. Mathematics of Computation, 91(333), 219-243. doi:10.1090/mcom/3655

Li, J., Bai, L., **Gao, W.**, Shi, N., Wang, N., Ye, M., . . . Liu, J. (2021). Reliability-based design optimization for the lattice boom of crawler crane. Structures, 29, 1111-1118. doi:10.1016/j.istruc.2020.12.024

Li, Q., Tian, Y., Wu, D., **Gao, W.**, Yu, Y., Chen, X., & Yang, C. (2021). The nonlinear dynamic buckling behaviour of imperfect solar cells subjected to impact load. Thin-Walled Structures, 169. doi:10.1016/j.tws.2021.108317

Li, W., Ma, H., & **Gao, W.** (2021). Geometrically exact beam element with rational shear stress distribution for nonlinear analysis of FG curved beams. Thin-Walled Structures, 164. doi:10.1016/j.tws.2021.107823

Li, Y. L., & **Zhao, X. L.** (2021). Experimental study on stainless steel blind bolted T-stub to square hollow section connections. Thin-Walled Structures, 167. doi:10.1016/j.tws.2021.108259

Li, Y. L., **Zhao, X. L.**, & Raman, R. S. (2021). Durability of seawater and sea sand concrete and seawater and sea sand concrete–filled fibre-reinforced polymer/stainless steel tubular stub columns. Advances in Structural Engineering, 24(6), 1074-1089. doi:10.1177/1369433220944509

Liu, L., Liu, A., Fu, J., Lu, H., **Pi, Y. L.,** & **Bradford, M. A.** (2021). Flexural-torsional buckling of shear deformable steel circular arches under a central concentrated load in a thermal environment. Engineering Structures, 242. doi:10.1016/j.engstruct.2021.112505

Liu, L., Lu, H., Liu, A., **Pi, Y. L.,** & **Bradford, M. A.** (2021). Lateral-Torsional Buckling of Shear Deformable Monosymmetric Steel I-Section Arches with Elastic Rotational-End Restraints under a Central Concentrated Load. Journal of Structural Engineering (United States), 147(2). doi:10.1061/(ASCE)ST.1943-541X.0002877

Liu, L., Lu, H., Liu, A., **Pi, Y. L., Bradford, M. A.,** Huang, Y., & Fu, J. (2021). Elastic lateral-torsional instability of monosymmetric shear deformable fixed arches under a localized uniform radial load. Thin-Walled Structures, 160. doi:10.1016/j.tws.2020.107394

Loizou, L., **Barati, K., Shen, X.,** & Li, B. (2021). Quantifying advantages of modular construction: Waste generation. Buildings, 11(12). doi:10.3390/buildings11120622

Mahmood, A. H., Babaee, M., Foster, S. J., & Castel, A. (2021). Continuous Monitoring of the Early-Age Properties of Activated GGBFS with Alkaline Solutions of Different Concentrations. Journal of Materials in Civil Engineering, 33(12). doi:10.1061/(ASCE)MT.1943-5533.0003997

Mahmood, A. H., Foster, S. J., & Castel, A. (2021). Effects of mixing duration on engineering properties of geopolymer concrete. Construction and Building Materials, 303. doi:10.1016/j.conbuildmat.2021.124449

Mahmood, S. M. F., Foster, S. J., & Valipour, H. (2021). Moment redistribution and post-peak behaviour of lightly reinforced-SFRC continuous slabs. Engineering Structures, 232. doi:10.1016/j.engstruct.2020.111834

Makasis, N., Kreitmair, M. J., **Bidarmaghz, A.**, Farr, G. J., Scheidegger, J. M., & Choudhary, R. (2021). Impact of simplifications on numerical modelling of the shallow subsurface at city-scale and implications for shallow geothermal potential. Science of the Total Environment, 791. doi:10.1016/j.scitotenv.2021.148236

Makki Alamdari, M., Chang, K. C., Kim, C. W., Kildashti, K., & Kalhori, H. (2021). Transmissibility performance assessment for drive-by bridge inspection. Engineering Structures, 242. doi:10.1016/j.engstruct.2021.112485

Makvandi, R., Abali, B. E., **Eisenträger, S.**, & Juhre, D. (2021). Revisiting Mindlin's theory with regard to a gradient extended phase-field model for fracture. PAMM, 20(1). doi:10.1002/pamm.202000104

Mazumder, M. H., **Gilbert, R. I.**, & Chang, Z. T. (2021). Analytical model for bond–slip behavior of the anchorage of deformed bars in reinforced concrete members subjected to bending. Journal of Building Pathology and Rehabilitation, 6(1). doi:10.1007/s41024-021-00126-1

Mehran Khoshoei, S., Mortazavi Bak, H., Mahdi Abtahi, S., Mahdi Hejazi, S., & **Shahbodagh, B.** (2021). Experimental Investigation of the Cyclic Behavior of Steel-Slag Ballast Mixed with Tire-Derived Aggregate. Journal of Materials in Civil Engineering, 33(2). doi:10.1061/(ASCE)MT.1943-5533.0003586

Miller, H. D., Akbarnezhad, A., Mesgari, S., & **Foster, S. J.** (2021). Effects of silane treatment on the bond between steel fibres and mortar. Magazine of Concrete Research. doi:10.1680/jmacr.20.00366

Moghaddasi, H., **Shahbodagh, B.**, & **Khalili, N.** (2021). A bounding surface plasticity model for unsaturated structured soils. Computers and Geotechnics, 138. doi:10.1016/j.compgeo.2021.104313

Moghaddasi, H., **Shahbodagh, B.**, Esgandani, G. A., **Khoshghalb, A.,** & **Khalili, N.** (2021). Generalized Mapping Rule for Image Point Identification in 3D Bounding Surface Plasticity Models. International Journal of Geomechanics, 21(6). doi:10.1061/(ASCE)GM.1943-5622.0002052

Mohammadi Golafshani, E., Arashpour, M., & **Kashani, A.** (2021). Green mix design of rubbercrete using machine learning-based ensemble model and constrained multi-objective optimization. Journal of Cleaner Production, 327. doi:10.1016/j.jclepro.2021.129518

Mohammed, T. U., **Mahmood, A. H.**, Apurbo, S. M., & Noor, M. A. (2021). Substituting brick aggregate with induction furnace slag for sustainable concrete. Sustainable Materials and Technologies, 29. doi:10.1016/j.susmat.2021.e00303

Mohammed, T. U., **Mahmood, A. H.**, Zunaied-Bin-Harun, M., Joy, J. A., & Ahmed, M. A. (2021). Destructive and non-destructive evaluation of concrete for optimum sand to aggregate volume ratio. Frontiers of Structural and Civil Engineering. doi:10.1007/s11709-021-0779-8

Mortazavi Bak, H., Kariminia, T., **Shahbodagh, B.**, Rowshanzamir, M. A., & **Khoshghalb, A.** (2021). Application of bio-cementation to enhance shear strength parameters of soil-steel interface. Construction and Building Materials, 294. doi:10.1016/j.conbuildmat.2021.123470

Nabati, A., Ghanbari-Ghazijahani, T., & **Valipour, H. R.** (2021). Innovative flitch sandwich beams with steel core under four-point bending. Engineering Structures, 233. doi:10.1016/j.engstruct.2020.111724

Negru, D. and **Hamed, E.** (2021), "Finite Element Analysis of Concrete Sandwich Panels Made with FRP Vierendeel-Truss Connectors". Concrete in Australia. 47(2): 46-51.

Nguyen, Q. D., Castel, A., **Kim, T.**, & Khan, M. S. H. (2021). Performance of fly ash concrete with ferronickel slag fine aggregate against alkali-silica reaction and chloride diffusion. Cement and Concrete Research, 139. doi:10.1016/j.cemconres.2020.106265

Ni, Y. C., Alamdari, **Makki Alamdari, M.**, Ye, X. W., & Zhang, F. L. (2021). Fast operational modal analysis of a single-tower cable-stayed bridge by a Bayesian method. Measurement: Journal of the International Measurement Confederation, 174. doi:10.1016/j.measurement.2021.109048

Nie, Y., & **Valipour, H. R.** (2021). Experimental and numerical study of long-term behaviour of timber-timber composite (TTC) connections. Construction and Building Materials, 304. doi:10.1016/j.conbuildmat.2021.124672

Nie, Y., Karimi-Nobandegani, A., & **Valipour, H. R.** (2021). Experimental behaviour and numerical modelling of timber-timber composite (TTC) joints. Construction and Building Materials, 290. doi:10.1016/j.conbuildmat.2021.123273

Pan, L., & **Chen, X.** (2021). Group Sparse Optimization for Images Recovery Using Capped Folded Concave Functions. SIAM Journal on Imaging Sciences, 14(1), 1-25. doi:10.1137/19m1304799

Petö, M., Duvigneau, F., Juhre, D., & **Eisenträger, S.** (2021). Enhanced integration scheme for unfitted polygonal elements. PAMM, 20(1). doi:10.1002/pamm.202000230

Qu, Y., Chen, D., Liu, L., Ooi, E. T., **Eisenträger, S.**, & **Song, C.** (2021). A direct time-domain procedure for the seismic analysis of dam–foundation–reservoir systems using the scaled boundary finite element method. Computers and Geotechnics, 138. doi:10.1016/j.compgeo.2021.104364

Robati, M., Oldfield, P., Nezhad, A. A., **Carmichael, D. G.**, & Kuru, A. (2021). Carbon value engineering: A framework for integrating embodied carbon and cost reduction strategies in building design. Building and Environment, 192. doi:10.1016/j.buildenv.2021.107620

Russell, A. R. (2021). Reply to the discussion by dallo on "influence of particle-size distribution homogeneity on shearing of soils subjected to internal erosion". Canadian Geotechnical Journal, 58(1), 154. doi:10.1139/cgj-2020-0239

Sakka, Z., & **Gilbert, R.I** (2021). Edge-clamped two-way slabs containing low-ductility steel. Structural Engineering and Mechanics, 78(6), 731-737. doi:10.12989/sem.2021.78.6.731

Saputra, A., Behnke, R., **Xing, W., Song, C.**, Schneider, J., & Kaliske, M. (2021). Numerical representation of fracture patterns and post-fracture load-bearing performance of thermally prestressed glass with polymer foil. Engineering Structures, 226. doi:10.1016/j.engstruct.2020.111318

Shaaban, A. M., Anitescu, C., **Atroshchenko, E.**, & Rabczuk, T. (2021). 3D isogeometric boundary element analysis and structural shape optimization for Helmholtz acoustic scattering problems. Computer Methods in Applied Mechanics and Engineering, 384. doi:10.1016/j.cma.2021.113950

Shafee, A., & **Khoshghalb, A.** (2021). An improved node-based smoothed point interpolation method for coupled hydro-mechanical problems in geomechanics. Computers and Geotechnics, 139. doi:10.1016/j.compgeo.2021.104415

Shahmirzadi, M. R., Gholampour, A., **Kashani, A.**, & Ngo, T. D. (2021). Shrinkage behavior of cementitious 3D printing materials: Effect of temperature and relative humidity. Cement and Concrete Composites, 124. doi:10.1016/j.cemconcomp.2021.104238

Siddika, A., **Hajimohammadi, A.**, & Sahajwalla, V. (2021). Powder sintering and gel casting methods in making glass foam using waste glass: A review on parameters, performance, and challenges. Ceramics International. doi:10.1016/j.ceramint.2021.10.066

Siddika, A., **Hajimohammadi, A.**, Ferdous, W, Sahajwalla, V. (2021) Roles of Waste Glass and the Effect of Process Parameters on the Properties of Sustainable Cement and Geopolymer Concrete—A State-of-the-Art Review. Polymers.

Siddika, A., **Hajimohammadi, A.**, Mamun, M. A. A., Alyousef, R., & Ferdous, W. (2021). Waste glass in cement and geopolymer concretes: A review on durability and challenges. Polymers, 13(13). doi:10.3390/polym13132071

Siddika, A., Mamun, M. A. A., Aslani, F., Zhuge, Y., Alyousef, R., & **Hajimohammadi, A.** (2021). Cross-laminated timber–concrete composite structural floor system: A state-of-the-art review. Engineering Failure Analysis, 130. doi:10.1016/j.engfailanal.2021.105766

Tafsirojjaman, T., Fawzia, S., Thambiratnam, D. P., & **Zhao, X. L.** (2021). FRP strengthened SHS beam-column connection under monotonic and large-deformation cyclic loading. Thin-Walled Structures, 161. doi:10.1016/j.tws.2021.107518

Tahir, M. N., & **Hamed, E.** (2021). Effects of temperature and thermal cycles on the mechanical properties of expanded polystyrene foam. Journal of Sandwich Structures and Materials. doi:10.1177/10996362211063152

Tiwari, R., & Lam, N. (2021). Modelling of seismic actions in earth retaining walls and comparison with shaker table experiment. Soil Dynamics and Earthquake Engineering, 150. doi:10.1016/j.soildyn.2021.106939

Tong, L. W., Niu, L. C., Ren, Z. Z., & **Zhao, X. L.** (2021). Experimental study on fatigue strength of welded joints of high strength steel Q550D. Gongcheng Lixue/Engineering Mechanics, 38(12). doi:10.6052/j.issn.1000-4750.2021.05.0364

Tong, L., Niu, L., Ren, Z., & **Zhao, X. L.** (2021). Experimental investigation on fatigue behavior of butt-welded high-strength steel plates. Thin-Walled Structures, 165. doi:10.1016/j.tws.2021.107956

Tong, L., Niu, L., Ren, Z., & **Zhao, X. L.** (2021). Experimental research on fatigue performance of high-strength structural steel series. Journal of Constructional Steel Research, 183. doi:10.1016/j.jcsr.2021.106743

Tong, L., Xu, G., **Zhao, X. L.**, & Yan, Y. (2021). Fatigue tests and design of CFRP-strengthened CHS gap K-joints. Thin-Walled Structures, 163. doi:10.1016/j.tws.2021.107694

Tootoonchi, A., & **Khoshghalb, A.** (2021). A smoothed meshfree method for simulation of frictional embedded discontinuities. Tunnelling and Underground Space Technology, 107. doi:10.1016/j.tust.2020.103666

Ullah, F., Sepasgozar, S. M. E., Shirowzhan, S., & **Davis, S.** (2021). Modelling users' perception of the online real estate platforms in a digitally disruptive environment: An integrated KANO-SISQual approach. Telematics and Informatics, 63. doi:10.1016/j.tele.2021.101660

Vahab, M., Hirmand, M. R., **Jafari, A.**, & **Khalili, N.** (2021). Numerical analysis of multiple hydro-fracture growth in layered media based on a non-differentiable energy minimization approach. Engineering Fracture Mechanics, 241. doi:10.1016/j.engfracmech.2020.107361

Vo, T., **Wang, Y.**, & **Russell, A. R.** (2021). The fall cone test in unsaturated soil and tailings pastes. Geotechnique. doi:10.1680/jgeot.20.P.128

Wang, Q., Wu, D., Li, G., & **Gao, W.** (2021). A virtual model architecture for engineering structures with Twin Extended Support Vector Regression (T-X-SVR) method. Computer Methods in Applied Mechanics and Engineering, 386. doi:10.1016/j.cma.2021.114121

Watts, M. J., Amin, A., Bernard, E. S., **Gilbert, R. I.**, & Facconi, L. (2021). Early age bond stress-slip behaviour of macro-synthetic fibre reinforced concrete. Construction and Building Materials, 301. doi:10.1016/j.conbuildmat.2021.124097

Watts, M. J., Amin, A., **Gilbert, R. I.**, Kaufmann, W., & Minelli, F. (2021). Simplified time-dependent crack width prediction for fiber reinforced concrete flexural members. Structural Concrete, 22(3), 1549-1560. doi:10.1002/suco.202000683

Wu, M., **Wang, J., Russell, A.**, & Cheng, Z. (2021). DEM modelling of mini-triaxial test based on one-to-one mapping of sand particles. Geotechnique, 71(8), 714-727. doi:10.1680/jgeot.19.P.212

Xu, H., Wang, C. C., **Shen, X.**, & Zlatanova, S. (2021). 3d tree reconstruction in support of urban microclimate simulation: A comprehensive literature review. Buildings, 11(9). doi:10.3390/buildings11090417

Xu, M., Li, X., Liu, T., Luo, Y., Huang, J., Wang, G., . . . **Gao, W.** (2021). A study on hollow effect and safety design of deep crossing caverns under blasting vibration. Tunnelling and Underground Space Technology, 111. doi:10.1016/j.tust.2021.103866

Xu, Y., **Shen, X.**, & Lim, S. (2021). CorDet: Corner-Aware 3D Object Detection Networks for Automated Scan-to-BIM. Journal of Computing in Civil Engineering, 35(3). doi:10.1061/(ASCE)CP.1943-5487.0000962

Xu, Y., **Shen, X.**, Lim, S., & Li, X. (2021). Three-Dimensional Object Detection with Deep Neural Networks for Automatic As-Built Reconstruction. Journal of Construction Engineering and Management, 147(9). doi:10.1061/(ASCE)CO.1943-7862.0002003

Ya, S., Eisenträger, S., Song, C., & Li, J. (2021). An open-source ABAQUS implementation of the scaled boundary finite element method to study interfacial problems using polyhedral meshes. Computer Methods in Applied Mechanics and Engineering, 381. doi:10.1016/j.cma.2021.113766

Yang, L., **Chen, X.**, & Xiang, S. (n.d.). Sparse Solutions of a Class of Constrained Optimization Problems. Mathematics of Operations Research. doi:10.1287/moor.2021.1194

Younas, S., Li, D., **Hamed, E.**, & Uy, B. (2021). Behaviour of high strength concrete-filled short steel tubes under sustained loading. Steel and Composite Structures, 39(2), 159-170. doi:10.12989/scs.2021.39.2.159

Yu, B., Cao, G., Huo, W., Zhou, H., & **Atroshchenko, E.** (2021). Isogeometric dual reciprocity boundary element method for solving transient heat conduction problems with heat sources. Journal of Computational and Applied Mathematics, 385. doi:10.1016/j.cam.2020.113197

Yu, B., Hu, P., **Saputra, A. A.**, & Gu, Y. (2021). The scaled boundary finite element method based on the hybrid quadtree mesh for solving transient heat conduction problems. Applied Mathematical Modelling, 89, 541-571. doi:10.1016/j.apm.2020.07.035

Yu, X., Al-saadi, S., Kohli, I., **Zhao, X. L.**, & Singh Raman, R. K. (2021). Austenitic stainless-steel reinforcement for seawater sea sand concrete: Investigation of stress corrosion cracking. Metals, 11(3), 1-10. doi:10.3390/met11030500

Yu, X., Al-Saadi, S., **Zhao, X. L.**, & Raman, R. K. S. (2021). Electrochemical investigations of steels in seawater sea sand concrete environments. Materials, 14(19). doi:10.3390/ma14195713

Yu, Y., **Gao, W.**, Castel, A., **Chen, X.**, & Liu, A. (2021). An integrated framework for modelling time-dependent corrosion propagation in offshore concrete structures. Engineering Structures, 228. doi:10.1016/j.engstruct.2020.111482

Yu, Y., **Gao, W.**, Feng, Y., Castel, A., **Chen, X.**, & Liu, A. (2021). On the competitive antagonism effect in combined chloride-sulfate attack: A numerical exploration. Cement and Concrete Research, 144. doi:10.1016/j.cemconres.2021.106406

Yu, Y., Zhang, T., Wang, Q., **Chen, X.**, Wu, D., **Gao, W.**, & Liu, A. (2021). Sensitivity of solidification hydration model in estimating carbonation of fly ash cement system. Construction and Building Materials, 282. doi:10.1016/j.conbuildmat.2021.122582

Zhang, J., Ankit, A., Gravenkamp, H., **Eisenträger, S.**, & **Song, C.** (2021). A massively parallel explicit solver for elasto-dynamic problems exploiting octree meshes. Computer Methods in Applied Mechanics and Engineering, 380. doi:10.1016/j.cma.2021.113811

Zhang, X., & **Russell, A. R.** (2021). Liquefaction Potential and Effective Stress of Fiber-Reinforced Sand during Undrained Cyclic Loading. Journal of Geotechnical and Geoenvironmental Engineering, 147(7). doi:10.1061/(ASCE)GT.1943-5606.0002530

Zhang, Y., Afroz, S., Nguyen, Q. D., **Kim, T., Eisenträger, J.**, Castel, A., & Xu, T. (2021). Analytical model predicting the concrete tensile stress development in the restrained shrinkage ring test. Construction and Building Materials, 307. doi:10.1016/j.conbuildmat.2021.124930

Zhang, Z., Liu, A., Fu, J., **Pi, Y. L.**, Liu, Y., & Huang, Y. (2021). Nonlinear in-plane buckling of fixed shallow arches with an orthotropic thin-walled section under uniform radial and thermal loading. Thin-Walled Structures, 165. doi:10.1016/j.tws.2021.107988

Zhao, Q., Zhang, D., **Zhao, X. L.**, & Sharma, S. (2021). Modelling damage evolution of carbon fiber-reinforced epoxy polymer composites in seawater sea sand concrete environment. Composites Science and Technology, 215. doi:10.1016/j.compscitech.2021.108961

Zhong, Z., Liu, A., Fu, J., **Pi, Y. L.**, Deng, J., & Xie, Z. (2021). Analytical and experimental studies on out-of-plane dynamic parametric instability of a circular arch under a vertical harmonic base excitation. Journal of Sound and Vibration, 500. doi:10.1016/j.jsv.2021.116011

Zhong, Z., Liu, A., **Pi, Y. L.**, Deng, J., Fu, J., & **Gao, W.** (2021). In-plane dynamic instability of a shallow circular arch under a vertical-periodic uniformly distributed load along the arch axis. International Journal of Mechanical Sciences, 189. doi:10.1016/j.ijmecsci.2020.105973

Zhou, C., Xiao, N. C., Zuo, M. J., & **Gao, W.** (2021). An Active Kriging-Based Learning Method for Hybrid Reliability Analysis. IEEE Transactions on Reliability. doi:10.1109/TR.2021.3111926

Zhou, C., Xiao, N. C., Zuo, M. J., & **Gao, W.** (2021). An improved Kriging-based approach for system reliability analysis with multiple failure modes. Engineering with Computers. doi:10.1007/s00366-021-01349-z

Zhou, Y., **Bidarmaghz, A.**, Makasis, N., & Narsilio, G. (2021). Ground-source heat pump systems: The effects of variable trench separations and pipe configurations in horizontal ground heat exchangers. Energies, 14(13). doi:10.3390/en14133919