UQ Summer Research Project Description

Project title:	**Fabrication of a demo Timber-FRP structure**
Project duration:	6 weeks (summer)
Description:	The student will be involved in the design, fabrication, and setup of a prototype timber-composite demo structure that will be placed in the Structures Lab in the Advanced Engineering Building.
Expected outcomes and deliverables:	The student will get a wide structural and fire engineering knowledge by participating in this project. The technology being used is shown here: https://futuretimberhub.org/projects/prototype-hybrid-timber-frp-enhanced-fire-and-serviceability-performance
Suitable for:	Civil, Mechanical, Chemical, Architecture
Primary Supervisor:	Dr Cristian Maluk
Further info:	c.maluk@uq.edu.au

UQ Summer Research Project Description

Timber Durability

Project title:	**Effect of fungal attack on glued timber connections**
Project duration:	Ten (10) weeks at 36 hours/week. Commencement date by mutual agreement.
Description:	Wood decay fungi can be highly destructive and a widespread cause of timber structures destruction, especially in tropical and sub-tropical areas. The fungal attack is classified mainly as brown rot or white rot. Joints or connections (such as nails or bolts) are often the weakest elements in timber structures. There is a considerable lack of information on the loss of performance of timber connections due to fungal attack. Therefore, understanding this performance loss can help fabricators design systems and guide builders in the designing of more durable structures. Methodology: (1) Measure moisture content and density in timber samples, (2) perform mechanical resistance tests in glued timber connections; (3) determine the decay level in timber samples exposed to white and brown rots.
Expected outcomes and deliverables:	Scholars will gain skills in a multidisciplinary research area, utilization of state-of-art equipment, data collection and interpretation. Publication of the outcomes is likely, and the project lends itself to a future undergraduate thesis or Masters project.
Suitable for:	This project is open to applications from EAIT and Faculty of Science, any level. Preference will be given to highly motivated students.
Primary Supervisor:	*Luis Yerman*
Further info:	Please contact supervisor at: l.yerman@uq.edu.au

UQ Summer Research Project Description

Timber Durability

Project title:	**Effect of fungal attack on nailed timber connections**
Project duration:	Ten (10) weeks at 36 hours/week. Commencement date by mutual agreement.
Description:	Wood decay fungi can be highly destructive and a widespread cause of timber structures destruction, especially in tropical and sub-tropical areas. The fungal attack is classified mainly as brown rot or white rot. Joints or connections (such as nails or bolts) are often the weakest elements in timber structures. There is a considerable lack of information on the loss of performance of timber connections due to fungal attack. Therefore, understanding this performance loss can help fabricators design systems and guide builders in the designing of more durable structures. Methodology: (1) Measure moisture content and density in timber samples, (2) perform mechanical resistance tests in nailed timber connections; (3) determine the decay level in timber samples exposed to white and brown rots.
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Suitable for:	This project is open to applications from EAIT and Faculty of Science, any level. Preference will be given to highly motivated students.
Primary Supervisor:	*Luis Yerman*
Further info:	Please contact supervisor at: l.yerman@uq.edu.au

UQ Summer Research Project Description

Project title:	**Physical modelling of hydraulic structures**
Project duration:	8 weeks
Description:	Theoretical and numerical studies of turbulent flows in hydraulic structures are complicated by the large number of relevant equations: i.e., three basic equations (continuity, momentum, energy), plus a mass transfer equation. Most studies rely upon some physical experiments with sophisticated instrumentations. Laboratory model studies are performed under controlled flow conditions with geometrically similar models. Hydraulic investigations will be conducted in the AEB hydraulics laboratory to predict the hydrodynamic performances of man-made structures. The project will aim to characterise the turbulence and the effects of flow turbulence on the optimum flow conditions.
Expected outcomes and deliverables:	The work will be conducted in the AEB hydraulic research laboratory. The student(s) will conduct some research experiments under academic supervision in a world-known research laboratory. They/he/she will gain skills in modelling and data processing, together with some critical analysis of the results. Student(s) may also be asked to produce a report or oral presentation at the end of the project.
Suitable for:	Suitable for Civil and Environmental Engineering students who successfully completed course in Fluid Mechanics (UQ equivalent: CIVL2131), and preferably Open Channel Hydraulics (UQ equivalent: CIVL3140), and are likely undertake a CIVL4580/4582 Research thesis or CIVL4560 Project in 2020, starting in semester 1. Preference will be given to highly motivated students. UQ enrolled students only. Pre-requisite: Successful completion of Fluid Mechanics courses equivalent to CIVL2131 Fluid mechanics.
Primary Supervisor:	Professor Hubert Chanson
Further info:	For further information, contact Professor Hubert CHANSON: Room 49-553 h.chanson@uq.edu.au

UQ Summer Research Project Description

Project title:	**Wave breaking in steady and unsteady open channel flows**
Project duration:	8 weeks
Description:	A sudden decrease in water depth, called a negative surge or expansion wave, is characterised by a gentle change in free-surface elevation. Some geophysical applications include the ebb tide flow in macro-tidal estuaries, the rundown of swash waters and the retreating waters after maximum tsunami runup in a river channel. A related application is the hydraulic jump and the dam break wave In the AEB hydraulics laboratory, new hydraulic engineering experiments will be conducted in a prismatic channel. The project will aim to characterise the unsteady turbulence and air entrainment during expansion waves as well as the effects of flow turbulence on turbulent stresses.
Expected outcomes and deliverables:	The work will be conducted in the AEB hydraulic research laboratory. The student(s) will conduct some research experiments under academic supervision in a world-known research laboratory. They/he/she will gain skills in modelling and data processing, together with some critical analysis of the results. Student(s) may also be asked to produce a report or oral presentation at the end of the project.
Suitable for:	Suitable for Civil and Environmental Engineering students who successfully completed course in Fluid Mechanics (UQ equivalent: CIVL2131), and preferably Open Channel Hydraulics (UQ equivalent: CIVL3140), and are likely undertake a CIVL4580/4582 Research thesis or CIVL4560 Project in 2020, starting in semester 1. Preference will be given to highly motivated students. UQ enrolled students only. Pre-requisite: Successful completion of Fluid Mechanics courses equivalent to CIVL2131 Fluid mechanics.
Primary Supervisor:	Professor Hubert Chanson
Further info:	For further information, contact Professor Hubert CHANSON: Room 49-553 h.chanson@uq.edu.au

UQ Summer Research Project Description

Project title:	**Computational Modelling of Internal Erosion in Embankment Dams**
Project duration:	10 weeks.
Description:	Internal erosion is the process of detachment and migration of soil particles under the action of seeping water. It is a major problem that affects the stability of embankment dams and flood levees. However, how the internal erosion process initiates and progresses cannot be easily observed from physical experiments. This is because the process originates at the particle-scale. When macro-scale erosion features are observed in the embankment dam, the erosion process has been ongoing for some time and intervention may not be possible. Hence, understanding the fundamental reasons how particles detach and are then transported has become a key research area within the geotechnical community. This project will aim to address these challenges using computational methods that model how discrete particles interact with a fluid field, that is, a fluid-particle system. This will be done using a method termed CFD-DEM. CFD or Computational Fluid Dynamics models the fluid field in a continuum manner using the Navier-Stokes equations adjusted for the presence of particles. DEM or Discrete Element Method models the individual particles based on Newton's Second Law. The coupling of these two numerical methods provides a powerful tool to explore the conditions under which internal erosion can take place. This project will utilise the open-source packages LAMMPS for DEM and OpenFOAM for CFD, which are coupled together by the CPL-Library, to conduct a range of erosion tests and develop fundamental understanding of the erosion process.
Expected outcomes and deliverables:	Scholars will be required to perform simulations of permeameter tests on various soil samples susceptible to internal erosion to understand how the material characteristics, the hydraulic conditions and the mechanical stress affects the detachment and transport of particles. The data generated from these simulations will be analysed using Matlab or Python. The key deliverables will be the data obtained from simulations along with the subsequent analysis, which will be embedded into a simulation library. The scholar will actively participate in the research group weekly forum and present their findings at the conclusion of the program. This project will expose scholars to cutting-edge open-source computational tools that are being actively developed by Dr Sufian. Scholars have the opportunity to contribute to this development and be recognised for their contributions. Moreover, scholars will greatly enhance their computational skills and broader research skills.

Suitable for:	This project is open to 3rd and 4th year Civil Engineering scholars, who have an interest in both fluid mechanics/hydrology and geotechnical engineering, as this project sits at the intersection of these two disciplines. A background in programming is not essential, so long as the scholar has a desire to learn and develop these skills. Note that this project can be completed remotely, should the scholar have concerns about physically attending campus.
Primary Supervisor:	Dr Adnan Sufian
Further info:	Please feel free to contact Dr Adnan Sufian (email: a.sufian@uq.edu.au) should any applicant wish to discuss this opportunity further. Meetings can be arranged physically or via Zoom.

UQ Summer Research Project Description

Project title:	**Particle-scale simulation of geotechnical laboratory tests**
Project duration:	10 weeks.
Description:	The shear strength and deformation characteristics of soils are typically obtained from laboratory tests such as triaxial compression tests and direct shear box tests. In these laboratory tests, a central aspect to soil behaviour is commonly overlooked, that is, that soils are composed of discrete particles which interact with each other to display complex behaviour. This project will investigate how the interaction of these discrete soil grains leads to the observations that we see in laboratory tests. This will help uncover the origins of shear strength in soils and why certain soils display deformation characteristics such as dilation when sheared. This will be achieved using a computational method termed the Discrete Element Method (DEM). DEM simulations employ Newton's Second Law to describe the interaction of many particles within a system and how they evolve with time under external loading. This project will utilise an open-source package, LAMMPS, to conduct the DEM simulations on High Performance Computing facilities at UQ.
Expected outcomes and deliverables:	Scholars will be required to run simulations of geotechnical laboratory tests, such as the triaxial tests, and process the simulation data in Matlab or Python. These simulations can be regarded as computational experiments, and thus, the scholar will establish an "experimental" programme to explore all relevant parameters. The key deliverables will be the data obtained from simulations along with the subsequent analysis, which will be embedded into a simulation library. The scholar will actively participate in the research group weekly forum and present their findings at the conclusion of the program. This project will expose scholars to cutting-edge research tools which will develop their computational and broader research skills. This will be invaluable irrespective of whether the scholar continues with academia or pursue other challenges in industry.
Suitable for:	This project is open to scholars with a background in Civil Engineering, who have completed the second-year Soil Mechanics course. A background in programming is not essential, so long as the scholar has a desire to learn and develop these skills. Note that this project can be completed remotely, should the scholar have concerns about physically attending campus.
Primary Supervisor:	Dr Adnan Sufian

Further info:	Please feel free to contact Dr Adnan Sufian (email: a.sufian@uq.edu.au) should any applicant wish to discuss this opportunity further. Meetings can be arranged physically or via Zoom.

Geotechnical Engineering Centre

UQ Summer Research Project Description – 1

Project title:	***Dynamic behaviour of a railway embankment and underlying expansive soil subgrade under wetting-dying and loading***
Project duration: ***Summer: 6-10 weeks***	*10 weeks at 36 hours/week.* *Commencement date by mutual agreement.*
Description:	*An instrumented tank is under development to investigate the hydrological-geotechnical behaviour of a railway embankment on an expansive soil foundation under repeated wetting-drying cycles, subjected to external loading. Soil sensors in the tank monitor profiles of moisture, suction and temperature in space and time, while the displacements of the embankment and subgrade are monitored by a high-resolution camera. External loads are added to simulate train operation.*
Expected outcomes and deliverables:	*The applicants can expect to gain experience in soil testing, sensor fabrication and their installation in a tank.* *Publication of the outcomes is likely and the project lends itself to a future undergraduate thesis or Masters project.*
Suitable for:	*Suitable for 2 to 4-year geotechnical engineering students with an interest in experimental design.*
Primary Supervisor:	*Professor David Williams and Dr Chenming Zhang*
Further info:	*Please email Chenming.Zhang@uq.edu.au for further details*

UQ Summer Research Project Description – 2

Project title:	***"Farming" to drain and desiccate red mud***
Project duration: ***Summer: 6-10 weeks***	*10 weeks at 36 hours/week.* *Commencement date by mutual agreement.*
Description:	*Drainage and desiccation of red mud will be carried out in two 800 mm long by 600 mm wide by 400 mm deep tanks exposed to an idealised laboratory or natural weather condition. Both tanks will be instrumented with moisture, suction, salinity and temperature sensors to monitor drainage, desiccation and cracking. The tailings in one of the tanks will be "farmed" by a scaled amphirol, while the other one will be left to desiccate naturally. The comparison study will reveal how much "farming" can accelerate the desiccation of the red mud.*
Expected outcomes and deliverables:	*The applicants can expect to gain experience in preliminary soil tests, sensor fabrication and installation in a tank.* *Publication of the outcomes is likely and the project lends itself to a future undergraduate thesis or Master project.*
Suitable for:	*Suitable for 2 to 4-year geotechnical engineering students with an interest in soil experimental design.*
Primary Supervisor:	*Professor David Williams and Dr Chenming Zhang*
Further info:	*Please email Chenming.Zhang@uq.edu.au for further details*

UQ Summer Research Project Description – 3

Project title:	***Fracture characteristics of asphalt mixes using high-speed photography***
Project duration: Summer: 6-10 weeks	*10 weeks at 36 hours/week.* *Commencement date by mutual agreement.*
Description:	*Fracturing in asphalt pavements is a nationwide problem. While new test procedures and monitoring equipment are continuously being developed, a better understanding and quantification of cracking of asphalt remains elusive. This project will investigate the failure response of asphalt mixes under various loading conditions (tensile and compressive stresses) captured at high frequencies using a stereo-pair of ultra-high speech camera system. Digital Image Correlation (DIC) will then be applied to understand crack initiation and crack propagation in asphalt mix designs for quality control and quality assurance of asphalt materials.*
Expected outcomes and deliverables:	*The applicant(s) can expect to gain experience in the testing of geomaterials for use in design.* *Publication of the outcomes is likely and the project lends itself to a future undergraduate thesis or Masters project.*
Suitable for:	*Suitable for 3 and 4-year geotechnical engineering students with an interest in laboratory testing of rocks.*
Primary Supervisor:	*Dr Mehdi Serati, Dr Ian Van Wijk (Aurecon), and Professor David Williams*
Further info:	*Please email M.Serati@uq.edu.au for further details*

UQ Summer Research Project Description – 4

Project title:	***Identifying crack initiation point in low porosity rock-like materials***
Project duration: Summer: 6-10 weeks	*10 weeks at 36 hours/week.* *Commencement date by mutual agreement.*
Description:	*The Crack Initiation (CI) point in a UCS test on rock specimens represents the stress level at which micro-fracturing begins and is the point at which the lateral and volumetric strain curves depart from linearity. Crack propagation can be considered as either stable or unstable. Under stable conditions, crack growth can be stopped by controlling the applied load. Unstable crack growth occurs at the point of reversal in the volumetric strain curve and is also known as the point of critical energy release or crack damage. This study will investigate the methods available in the literature for determining this critical design parameter in low porosity rocks. The models will be then applied to conventional and true triaxial test data to compare the results and assess the applicability of each model.*
Expected outcomes and deliverables:	*The applicants can expect to gain experience in the testing of geomaterials for use in design.* *Publication of the outcomes is likely and the project lends itself to a future undergraduate thesis or Masters project.*
Suitable for:	*Suitable for 3 and 4-year geotechnical engineering students with an interest in laboratory testing.*
Primary Supervisor:	*Dr Mehdi Serati*
Further info:	*Please email M.Serati@uq.edu.au for further details*

UQ Summer Research Project Description – 5

Project title:	***Seismic risk and large open pit slope stability***
Project duration: Summer: 6-10 weeks	*10 weeks at 36 hours/week.* *Commencement date by mutual agreement.*
Description:	*Earthquakes have been responsible for initiating rock slope failures varying in size from minor landslides limited to one or more rock blocks, up to major collapse involving whole mountainsides. Probably the most infamous of these failures is the Nevados Huascarán rock avalanche triggered by the 1970 (M=7.75) earthquake in Peru. This landslide resulted in the deaths of over 200,000 people. However, while there are many earthquake-triggered failures in natural slopes and tailing dams, very few such failures have been reported in large open-pit mines. Chilean mine sites, for instance, are frequently subjected to moderate and deep earthquakes, but have shown little to no severe earthquake-induced instabilities. Nevertheless, in 2007, a major earthquake of 7.7 magnitude struck northern Chile and caused a bench-scale wedge failure in the Cerro Colorado copper mine, leading to the increase of required static Factor of Safety from 1.3 to 1.5. This resulted in a huge cost increase due to slope flattening. This project will collect a database on the dynamic response of large open pits worldwide to earthquake loading, indicating whether or not earthquakes are a credible pit slope stability hazard.*
Expected outcomes and deliverables:	*The applicants can expect to gain experience in deep understanding of open pit design and earthquake principal from a rock mechanics point of view.* *Publication of the outcomes is likely and the project lends itself to a future undergraduate thesis or Masters project.*
Suitable for:	*Suitable for 3 and 4-year mining and geotechnical engineering students with an interest in laboratory testing.*
Primary Supervisor:	*Dr Mehdi Serati, and Mr Rigo Rimmelin (BHP)*
Further info:	*Please email M.Serati@uq.edu.au for further details*

UQ Summer Research Project Description – 6

Project title:	***Ring test optimisation of shotcrete under restrained shrinkage cracking***
Project duration: Summer: 6-10 weeks	*10 weeks at 36 hours/week.* *Commencement date by mutual agreement.*
Description:	*Since shotcrete (sprayed concrete) has been used until recently mainly for temporary support, the evaluation of shotcrete shrinkage cracking has not attracted much attention. Under current practice, only free shrinkage is measured from small-sized specimens prepared from the supplied concrete. There is potential to modify the standard thin ring test to a thick ring test for shotcrete sampled in situ to enable quantitative assessment. Geometry optimisation, stress-strain distribution analysis on cracked rings, and scale effect will be included in this project.*
Expected outcomes and deliverables:	*The applicants can expect to gain experience in design, instrumentation, and calibration of a ring test, as well as insight into tunnelling and underground construction.* *Publication of the outcomes is likely and the project lends itself to a future undergraduate thesis.*
Suitable for:	*Suitable for 3 and 4-year **civil or geotechnical engineering** students with an interest in laboratory testing and numerical modelling.*
Primary Supervisor:	*Dr Jurij Karlovsek, Prof Harry Asche and Mr Zhongyu Xu*
Further info:	*Please email j.karlovsek@uq.edu.au for further details*

UQ Summer Research Project Description – 7

Project title:	***Restrained shrinkage cracking potential evaluation of fibre-reinforced shotcrete using ring test***
Project duration: Summer: 6-10 weeks	*10 weeks at 36 hours/week.* *Commencement date by mutual agreement.*
Description:	*Cracking of shotcrete lining restrained by the substrate under drying conditions becomes a durability issue in civil tunnelling. The standard ring tests utilises a concentric steel ring inside a concrete ring to replicate restrained shrinkage of a shotcrete ring. However, such a test only provides data when the test is terminated, and is inadequate for the time-dependent assessment of the effect of reinforcement fibres. A new energy approach will be applied to gain more understanding of cracking of fibre-reinforced shotcrete with time.*
Expected outcomes and deliverables:	*The applicants can expect to gain experience in concrete testing, instrumentation, calibration of a ring test as well as the insight of tunnelling and underground construction.* *Publication of the outcomes is likely and the project lends itself to a future undergraduate thesis.*
Suitable for:	*Suitable for 3 and 4-year **civil or geotechnical engineering** students with an interest in laboratory testing.*
Primary Supervisor:	*Dr Jurij Karlovsek, Prof Harry Asche and Mr Zhongyu Xu*
Further info:	*Please email j.karlovsek@uq.edu.au for further details*

UQ Summer Research Project Description – 8

Project title:	***Infrastructure sustainability ratings – Exploring circular economy principles***
Project duration: Summer: 6-10 weeks	*10 weeks at 36 hours/week.* *Commencement date by mutual agreement.*
Description:	*Sustainability can be defined in many ways. A simple definition is the balancing of economic, environmental, and social impacts. The IS Rating Scheme is Australia and New Zealand's only comprehensive rating system for evaluating sustainability across the planning, design, construction and operational phases of infrastructure assets. IS evaluates the sustainability performance of the quadruple bottom line (Governance, Economic, Environmental and Social) of infrastructure development.*
Expected outcomes and deliverables:	*The applicant can expect to gain experience in operational benchmarking tools to rate the sustainability of infrastructure assets focused on the IS Rating Scheme* and Eco-Efficiency Analysis**.* **ISCA's IS Rating Scheme is a method of rating and advancing sustainability outcomes in infrastructure by improving the productivity and liveability of industry and communities. The IS Rating Scheme was launched to promote infrastructure sustainability and is a voluntary third-party assured assessment that evaluates the sustainability performance of infrastructure assets.* ***The Eco-Efficiency Analysis (EEA) is a tool for assessing products and processes on a comprehensive and comparative basis. The entire life cycle of a product is considered – this includes the environmental impact of the materials used, the use of the product by customers and end consumers as well as options for recycling and disposal.* *Publication of the outcomes is likely and the project lends itself to a future undergraduate thesis.*
Suitable for:	*Suitable for 2, 3 and 4-year **civil engineering** students with an interest in inter-disciplinary work.*
Primary Supervisor:	*Dr Jurij Karlovsek and Dr Cristyn Meath*
Further info:	*Please email j.karlovsek@uq.edu.au for further details*