UQ Summer Research Project Description

Project title:	**Physical modelling of Australian indigenous water structures**
Project duration:	8-10 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 Australian indigenous water structures. The project will aim to characterise the interactions between flood flow and structures
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 2021, 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. The project will include interactions with HASS researchers and students. **The project requires all on-campus work**.
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:	**Physical modelling of hydraulic structures**
Project duration:	8-10 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 2021, 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. **The project requires all on-campus work**.
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:	8-10 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. **The project requires all on-campus work**
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:	**Long term trends in Brisbane River sediment distribution**
Project duration:	This will be an 8-week project.
Description:	Sediment distribution in the Brisbane River estuary is driven by two key variables: catchment inflow events and tidal reworking. Catchment inflow events transport large quantities of fine sediment material which is then deposited in the estuary. Following the initial deposition, strong tidal currents can then redistribute this material within the estuary and then eventually export into Moreton Bay. This project will examine a 20-year record of sediment particle size data at multiple sites throughout the lower estuary and identify long term trends in sediment distribution.
Expected outcomes and deliverables:	Students will gain strong data and laboratory analysis skills over this project. The laboratory component will require on-campus work for at least 2 weeks over the duration of the project. Students will be expected to produce a technical report detailing the major findings from this work. In addition, there will be the opportunity for students to present to key external stakeholders including the Port of Brisbane and Healthy Land and Water.
Suitable for:	Students with a strong interest in statistical analysis. A working knowledge of sediment particle size analysis and GIS techniques is highly desirable.
Primary Supervisor:	Alistair Grinham
Further info:	Email: a.grinham@uq.edu.au

UQ Summer Research Project Description

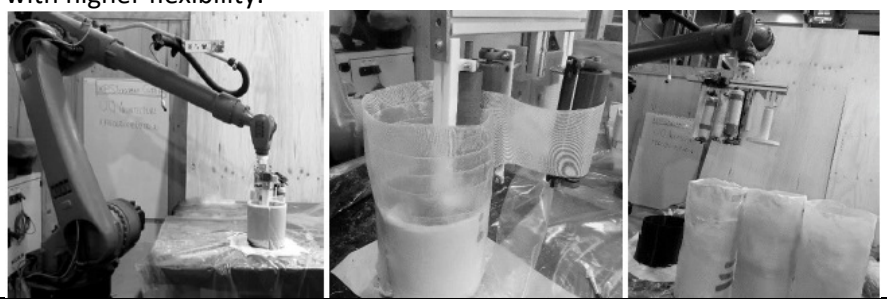
Project title:	**Investigation on robotic fabrication approach of structure with FRP composite material**
Project duration:	*10 weeks*
Description:	Recent studies on topology optimization have found that material efficiency can be significantly improved by using irregular sections to replace the conventional sections in some structural members. The optimized structures are also tended to be with changing cross-sections along the member span or height, such as the tree-like structure used at the Qatar National Convention Centre (Figure 1) and the Art Nouveau Apartment by Flying Concrete in San Miguel De Allende Mexico. FRP is found to be a promising material for the irregular profiles because of its high flexibility. However, as above mentioned, conventional manufacturing techniques have their limitations on irregular shapes.  Figure 1 Qatar National Convention Centre, Doha. https://www.designbuild-network.com/projects/qatarnationalconvent/ Our research is introduced to explore the potential to use robotic technology for robotic fabrication of structural members with greater formwork flexibility to reduce the cost of transportation and to increase the material and structural efficiency of the building structure. Some preliminary research has been conducted on FRP formwork fabrication by industrial robot in Figure 2. Based on this experience, next step will upgrade fabrication system and explore more geometrical design with higher flexibility. 

	Figure 2 Robotic FRP formwork fabrication
Expected outcomes and deliverables:	The scholar will gain skills in geometrical optimization for robotic fabrication, basic industrial robot control and path planning for fabrication/construction, design and developing adaptive fabrication system for customizable building components. The scholar will also gain more skills in lab work and be more familiar with hand tools. The scholars are expected to deliver a fabricated prototype at the end of the project and evaluate the system. There will be opportunity to generate publication based on the outcome of the research.
Suitable for:	The project is open for senior undergraduate and master students in Civil and Architecture. Previous experience with FRP composite material or related CAD software (Rhino&Grasshopper is preferred). The students must gain access the structure lab and industrial robotic arm by completing all relevant inductions before the research start.
Primary Supervisor:	Dr. Dan Luo
Further info:	Dan Luo d.luo@uq.edu.au Please contact the supervisor prior to submission

UQ Summer Research Project Description

Project title:	**Identifying Crack Initiation Point in Low Porosity Rock-like Materials**
Project duration:	*10 weeks at 37.5 hours/week.* *Commencement date by mutual agreement.*
Description:	*The Crack Initiation (CI) point in a UCS test with rock-like samples represents the stress level where microfracturing begins and is marked as the point where the lateral and volumetric strain curves depart from linearity. Crack propagation can be considered as being 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 aims to investigate the available methods in the literature for the determination of this critical design parameter in low porosity rocks. The models will be then applied to a series of 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, Prof David Williams*
Further info:	*Please email M.Serati@uq.edu.au for further details*

UQ Summer Research Project Description

Project title:	**On the Evaluation of Crack Initiation Stress Threshold using electrical resistivity methods**
Project duration:	*10 weeks at 37.5 hours/week.* *Commencement date by mutual agreement.*
Description:	*The rapid expansion of urban and mining infrastructure over the last two decades has seen an escalation of development in hard rocks, including urban tunnels, large open pits, and deep underground mines. However, despite many success stories, explosion-like fractures at depth (commonly known as spalling and rock bursts) still happen. This highly contentious rock failure is found closely related to the initiation of internal cracks in rock where the sample deformation could still be within the elastic zone. The crack initiation threshold, defined as the onset of stress-induced rock damage, has been therefore widely used as a predictor for in-situ rock spalling strength. The aim of this study is to investigate the applicability of two low-frequency electrical geophysical methods for the determination of crack initiation stress thresholds in hard and brittle solids. Firstly, an active method will be considered: the Spectral Induced Polarization (SIP). The main idea is to inject electrical current in the rock and measure the electrical potential in order to compute the frequency dependant complex permittivity of the material. The method being very sensitive to change in porosity, it can be used as a monitoring technique for crack initiation. The self potential method is a passive geophysical method and consists of measuring the electrical potential. The sampled electrical potential can be used to determine the causative source of current in the material. In the case of crack initiation, an electrical current can be induced thorough the seismoelectric coupling.*
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

Project title:	**Rock Damage Behaviour at Elevated Temperature**
Project duration:	*10 weeks at 37.5 hours/week.* *Commencement date by mutual agreement.*
Description:	*One of the most common rock failure types in deep underground structures is rockburst (also know as strainburst, pillar burst, and fault-slip burst) where large quantities of rock fragments are ejected from the excavation boundary with high kinetic energy. Rock burst events bear the potential for fatal incidents and equipment damage or loss. Understanding the mechanisms that lead to an explosion-type rockburst failure is therefore critical for a safe underground environment and successful underground operation. While rockburst type failures have been studied extensively including through field observations, experimental and theoretical investigations as well as numerical modelling and in-situ monitoring; the true mechanism has not yet been completely understood to its full extent. In particular, thermo-mechanical damage behaviour of rock under high-stress conditions during rockburst requires further investigations and prevention efforts. In this study, various Brazilian test samples will be tested at elevated temperatures of up to 300^o using image processing and high-speed photography techniques to assess the fracture formation of brittle rocks under coupled Thermo-mechanical stresses.*
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, Prof David Williams*
Further info:	*Please email M.Serati@uq.edu.au for further details*

UQ Summer Research Project Description

Project title:	**Assessing fire safety of timber infrastructure**
Project duration:	6 to 8 weeks
Description:	Timber is a combustible material, however, if properly designed many timber infrastructure elements can still maintain their intended function during and after fire. The Fire Safety Research Group at UQ work in close collaboration with the National Centre for Timber Durability and Design Life to better understand the fire behaviour of timber and how this can knowledge can be implemented to improve the response of timber to fire. This particular programme will look at the burning behaviour of timber that contains added chemicals to improve its durability against fungi and termites. This will involve experimental investigation of timber with and without treatment at multiple scales. The aim is to identify conditions that cause combustion to continue in timber after a fire has passed or exhausted its non-timber fuel supply. The work will consist of experimental fire experiments in our state-of-the-art fire laboratory on campus.
Expected outcomes and deliverables:	Students will work closely with current doctoral students, which will help those who have little or no experience with timber or experimental work in general. Through the experimental work students will gain valuable laboratory skills and an insight into fire safety testing. They will learn how to measure various important fire quantities and how to interpret results. Good work/results will directly contribute to research publications, in which summer students will be invited to participate; this can be helpful for those that wish to apply for post graduate research positions in the future. It is expected that students attend meetings with the supervisor of the project, as well as with the fire safety research group.
Suitable for:	There are no specific requirements for this project, other than an interest in experimental work, plus a willingness to learn.
Primary Supervisor:	Dr Felix Wiesner

Further info:	For further information regarding the projects, please contact: Dr Felix Wiesner: f.wiesner@uq.edu.au

UQ Summer Research Project Description

Project title:	**Dynamic behaviour of a railway embankment and underlying expansive soil subgrade under weathering and loading**
Project duration: ***Summer: 6-10 weeks***	*10 weeks at 37.5 hours/week.* *Commencement date by mutual agreement.*
Description:	*An instrumented tank is established to investigate the hydrological-geotechnical behaviours of a railway embankment on an expansive soil foundation under repeated wetting-drying cycles, subjected to external loading. Soil sensors are instrumented in the tank to monitor the spatiotemporal profiles of moisture, suction and temperature while the displacement of embankment and subgrade is monitored by a high-resolution camera. External loads are added to simulate the train operation.*
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 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

Project title:	**"Farming" to drain and desiccate red mud**
Project duration: ***Summer: 6-10 weeks***	*10 weeks at 37.5 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 remain undisturbed. The comparison study would reveal how much "farming" will accelerate the dewatering process of the tailings.*
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 experimental design.*
Primary Supervisor:	*Professor David Williams and Dr Chenming Zhang*
Further info:	*Please email Chenming.Zhang@uq.edu.au for further details*