2023 Winter Research Project Description

UQ School of Civil Engineering

Project title:	**Physical modelling of hydraulic structures**
Project duration, hours of engagement & delivery mode	Duration of the project: 4 weeks during Winter Vacation. Hours of engagement: 36hrs per week On-site attendance is required. The project will take place full-time on campus in the AEB Hydraulics Laboratory
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 and possibly 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 CIVL4583/4582 Research thesis or CIVL4560 Project in 2023 or 2024. 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 and be full-time project
Primary Supervisor:	Professor Hubert Chanson
Further info:	For further information, contact Professor Hubert CHANSON: Room 49-553 h.chanson@uq.edu.au

2023 Winter Research Project Description

UQ School of Civil Engineering

Project title:	Proximate and ultimate analyses of Australian timber species
Project duration, hours of engagement & delivery mode	4 weeks, 36 hours per week. Mainly experimental work at the Fire safety lab at AEB (#49), St Lucia
Description:	Timber is an important construction material used for housing, commercial buildings, and infrastructure projects. Proximate analysis is a way to determine the distribution of products when the timbers are heated under specified conditions. Proximate analysis is to find out the volatile matter, ash, fixed carbon, and moisture content. The ultimate analysis aims to determine the elemental composition of different timber species, such as carbon, hydrogen, nitrogen, sulfur, and oxygen content. Those results can provide information when comparing thermal degradation behavior (e.g., in flaming and smouldering combustion) between different timber species. This project will constitute four work packages. Supervisors will instruct all the experimental work that will happen in Civil Engineering School and UQ Fire Laboratory: 1. Sample preparation and conditioning process (environmental chamber and general tools will be used). 2. Perform proximate analyses (muffle furnace will be used).
Expected outcomes and deliverables:	Applicants will gain work experience in a laboratory environment and equipment, as well as skills in data analysis, results interpretation and international standards. Students will be asked to produce a small report at the end of their project.
Suitable for:	This project is open to applications from students with a background and/or interest in fire.
Primary Supervisor:	Dr Luis Yerman l.yerman@uq.edu.au
Further info:	Please contact supervisor for further information and prior to submitting an application.

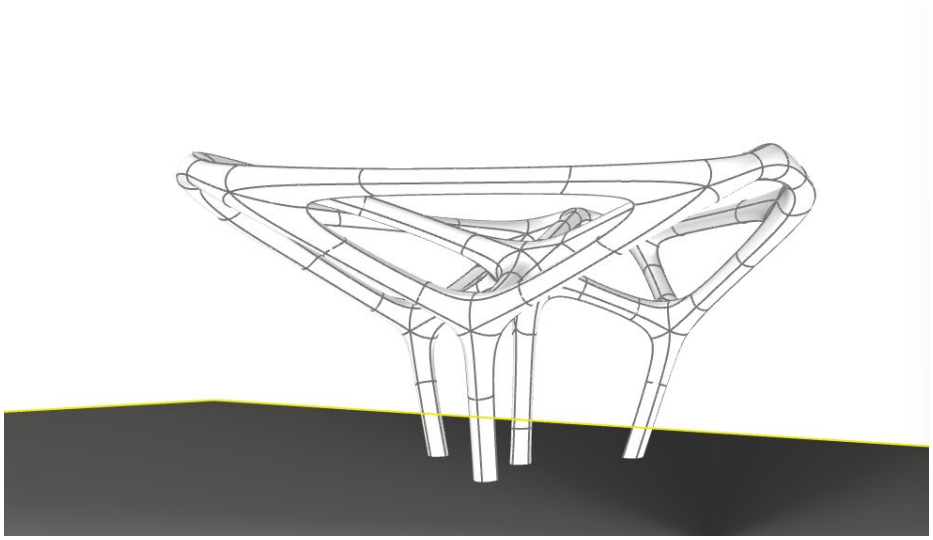
2023 Winter Research Project Description

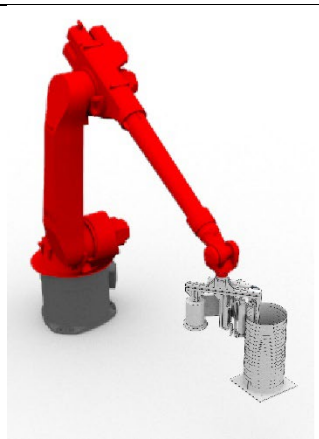
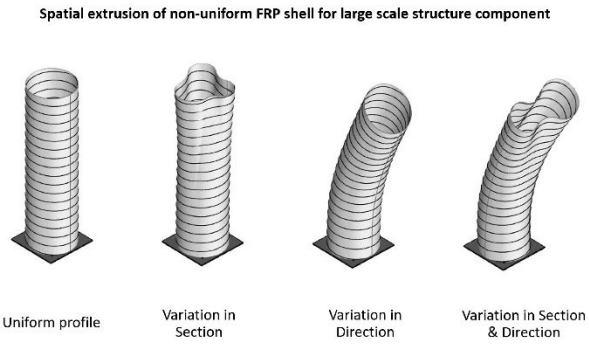
UQ School of Civil Engineering

Project title:	Biomineralization process for civil engineering applications
Project duration, hours of engagement & delivery mode	4 weeks 36 hours per week and applicant will be required on-site for the project.
Description:	The use of bacterially induced carbonate biominerals is becoming increasingly popular day by day. Applications include removal of heavy metals and radionucleotides, biodegradation of pollutants, atmospheric CO2 sequestration, remediation of building materials and for improving of soil stability. This technique, also known as microbially induced calcite precipitation (MICP), refers to the precipitated calcium carbonate which binds soil particles together to increase the strength and occupy the pore spaces to reduce permeability of the soil. Still there has been much to explore in order to bring this environmentally safe, cost effective and convenient technology from lab to field scales. In this context, carefully designed experimental studies of chemical mineralisation and biomineralization at defined environments would help to determine parameters that dominate these processes by using electrical methods. The aim of this project is to carry laboratory experiments that can allow modelling of the spectral induced polarization (SIP) response the mineralisation process.
Expected outcomes and deliverables:	The Scholar(s) will gain skills in laboratory testing, and in the interpretation of test results for application to practice. A report has to be prepared presenting the results of the project. Depending on the results of the research it is intended to publish a paper with the participation of the Scholar(s).
Suitable for:	This project is open to applications from students with a background in Civil, Environmental Engineering or chemistry, 3-4 year students, UQ enrolled students only with a practical, investigatory mind.
Primary Supervisor:	Denys Villa Gomez
Further info:	Please contact Denys at d.villagomez@uq.edu.au, this project is open to one student.

2023 Winter Research Project Description

UQ School of Civil Engineering / School of Architecture

Project title:	**Robotic FRP fabrication with a customized non-standard geometry**
Project duration, hours of engagement & delivery mode	4 weeks Onsite
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 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 The fabrication method proposed to investigate is developed inspired by the novel hybrid double-skin tubular arch bridge system developed in UQ, in which prefabricated FRP tubes are used both as formworks for concrete casting and as reinforcement to construct a hybrid bridge structure.  Based on this system of construction, 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.

	 
Expected outcomes and deliverables:	Scholars may gain skills in basic industrial robot control, non-standard geometry design optimization, robotic fabrication path planning, prototype fabrication experience. The scholars are expected to deliver an adaptive path planning for robotic fabrication with non-standard FRP tube geometry. Design and fabrication of a jointing system between robotic fabricated subassemblies will also be required. A final customized concrete-filled FRP tube prototype will be fabricated if applicable. There will also be an opportunity to generate publication based on the prototype geometry design pattern and the robotic fabrication method.
Suitable for:	This project is open to senior undergraduate and master students with a background of civil engineering or architecture. One for civil engineer and one for architecture are preferred. Students owning previous experience with FRP/concrete or rhino/grasshopper will be in higher priority. The students must gain access to the structure lab and industrial robotic arm by completing all relevant inductions before the research program.
Primary Supervisor:	Dan Luo
Further info:	Dan Luo d.luo@uq.edu.au Please contact the supervisor prior to submission