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Winthrop Professor Carolyn Oldham: Supervisor (5 Projects)

Topic 1: Water sensitive urban design (WSUD) in areas with significant groundwater – surface water interactions.

Topic 2: Transport of seagrass wrack on and off WA beaches.

Topic 3: Effectiveness of oxygen injection for prevention of hydrogen sulfide accumulation in Water Corporation pipes.

Topic 4: Pressure affects on calibration of underwater stereo video cameras.

Topic 5: Consolidation of mine tailings

Winthrop Professor Charitha Pattiaratchi: Supervisor (1 Project)

Topic 1: Coastal sediment transport and stability along the Perth Metropolitan region

Asst/Professor Elke Reichwaldt: Supervisor (1 Project)

Topic 1: Environmental risks of natural and engineered (WSP) water waterbodies

Winthrop Professor Keith Smettem: Supervisor (3 Projects)

Topic 1: Developing a hydrologic understanding of the Pilbara and Gascoyne regions.

Topic 2: Vortex-induced dispersion to chemical transport in channels.

Topic 3: Design of an artificial wetland for nutrient removal at the University Farm

Asst/Professor Yinghui Tian (COFS): Supervisor (1 Project)

Topic 1: Numerical investigation on the bearing capacity of shallow and deeply buried footings

Research Associate Cristina Vulpe: Supervisor (1 Project)

Topic 1: Effect of consolidation on the combined capacity of shallow footings. Numerical study

Winthrop Professor Anya Waite: Supervisor (5 Projects)

Topic 1: Oceanography of the Eastern Indian Ocean

Topic 1: Controls of biogeochemical fluxes and climate links

Topic 2: Plankton Populations associated with Whalesharks at Ningaloo

Topic 3: Understanding variation in of continuous Water Quality Monitors (WQMs) against pigments and phytoplankton measures from in situ sampling.

Topic 4: Power comparisons of sampling strategies between historical monthly water sampling and modern 15 minute samples from sensors.

Topic 5: Biogeochemical modelling, from physics to a second trophic order, seasonal cycles in Australian coastal waters

Professor Tongming Zhou: Supervisor (3 Projects)

Topic 1: Experimental investigation of aerodynamic loads on an overland causeway truss

Topic 2: Vortex shedding from a yawed bluff body with rectangular cross-section and its dependent on Reynolds numbers and inclination angles

Topic 3: Experimental studies of passive control of vortex shedding from a circular cylinder
Waste for Life Sri Lanka.

Discipline: Mechanical / Materials / Environmental
Suitable for 6 Students
Two project areas are proposed within this topic: between them they can accommodate three students each

Topic 1: **Technical feasibility of manufacturing a hotpress for a natural fibre composite project in Sri Lanka.**
Initial feasibility studies have been carried out on a potential WfL project in Sri Lanka. Further research needs to be carried out on the feasibility of making a hotpress on the ground, using locally sourced materials. This research will include;

- identifying designers/manufacturers for the hotpress and any ancillary technology
- materials requirement and availability
- energy and financial requirements

Topic 2: **Developing new composite materials and products from natural fibres and waste plastic in a Sri Lankan context.**
During the initial research locally available waste materials that can be used for materials development were identified. Further research will be required to see what type of materials and products can be made to suit the local market. This will include;

- identifying support for product designs, materials and product development
- identifying manufacturing systems and marketing
- developing a product marketing and distribution strategy based upon market research

Mining and its social impact.

Topic 3: **Developing new composite materials and products from natural fibres and waste plastic in a Sri Lankan context.**

Discipline: Civil, Mining & Environmental Engineering
Suitable for 4 Students
Students will work within a program area on the above theme on two interrelated projects

1. The purpose and effectiveness of cultural awareness training (CAT) in the mining industry
2. Evaluating experiences of community engagement practices within mining projects

Doctor Kaiming Bi: Supervisor (3 Projects)
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Topic 1: **Seismic analysis and assessment of highway bridges**

Discipline: Civil Engineering, Structural Engineering
Suitable for 3 students

Long-span highway bridges are vulnerable to earthquake loadings. Various factors influence the seismic responses of bridge structures. This project carries out numerical studies on the seismic responses of long-span highway structures by using the finite element code SeismoStruct.

One student will investigate the influence of spatially varying ground motions on the seismic responses of a highway-bridge, which includes the influences of wave passage effect, coherency loss effect, local site effect and soil-structure interaction.
Another student will investigate the influence of boundary conditions and bridge geometries on the seismic responses, which includes the influences of fix support, pin support and the skewness angle of the bridge.

The third student will investigate the influence of nonlinearities, which includes material nonlinearity and geometric nonlinearity.

**Topic 2:** Influence of exterior shear keys on the seismic responses of bridge structures and seismic retrofitting  
*Discipline: Civil Engineering, Structural Engineering*  
*Suitable for 2 students*

Shear keys are used to restrain the lateral responses of bridge structures under earthquake loading. Exterior shear keys can significantly influence the seismic responses of bridge structures. This project aims to investigate the influences of shear keys on the seismic damage of bridge structures by using explicit element code LS-DYNA. One student will investigate the influence of two types of shear keys. Another student will focus on the damage retrofitting by using rubber pad and/or FRP.

**Topic 3:** Numerical investigation of simply-supported bridge structures to avoid earthquake induced pounding and unseating  
*Discipline: Civil Engineering, Structural Engineering*  
*Suitable for 2 students*

Earthquake induced pounding and unseating damage were repeatedly observed in previous major earthquakes. The most directive way to avoid seismic pounding is to provide sufficient separation distances between different components of bridge structures. Similarly, sufficient seating lengths are required to prevent the unseating damage. This project aims to investigate the required separation distances and required unseating lengths to avoid these adverse damages by using the explicit finite element code LS-DYNA. One student will focus on separation distance investigation while another student will concentrate on the required unseating length investigation.

Research Associate Wensu Chen: Supervisor (1 Project)  
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**Topic 1:** Laboratory testing and numerical simulation of new developed composite SIP panels against windborne debris impacts  
*Discipline: Civil and Structural Engineering*  
*Four (4) students are needed to work on this project together. Two students will focus on testing and new development of SIPs. Two students will concentrate on the numerical simulation.*

**Co-Supervisor:** Winthrop Professor Hong Hao (UWA)

Natural disasters such as cyclone, hurricane and typhoons took place around the world, which cause tremendous loss and damage. Damages of building structures by windborne debris impacts have been reported in almost all the previous major wind events. The windborne debris usually imposes high speed localized impact on the building envelope, which may harm occupants inside the building and create dominant openings. A dominant opening in the building envelope might cause internal pressure increasing and result in substantial damage to the building structures, such as roof lifting up or even collapse. To withstand the impact of such extreme event, the penetration resistant capacity of wall or roof panels to windborne debris impact should meet the requirements specified in the wind loading codes.

In our previous study, a total of 36 various structural panels subjected to windborne debris impacts have been tested. All tested specimens could not pass the test subjected to a timber rod impact at velocity 40m/s, which is required for structural panels in some regions defined in the Australian Standard 1170.2 (2011). This project will develop some new composite panels. For instance, the penetration resistant capacities of existing structural panels can be improved in ways of using new ductile materials skin or interlayer (such as FRP, PVB, etc.), new forms of cores (such as EPS with cement, polymer of various densities, etc.) and new structural development (such as boundary supports and connections). The dynamic impact tests on the developed panels will be carried out and the
penetration resistance capacity of panels will be discussed and analysed. The static and dynamic tests on the new materials properties will be conducted. Laboratory static tests (bending, axial and shear) of new composite panels will also be carried out. Two students will be involved in this sub-project.

Seven fibre cement skin SIPs and Seven OSB skin SIPs have been tested in our previous study. Structural insulated panel is a lightweight composite structure which is used in a wide range of commercial, industrial and residential building industry. It consists of insulating polymer foam sandwiched by two layers of structural skins. Two layers of skins can be metal sheet, fibre cement sheet, plywood sheet and oriented strand board (OSB) etc. The foam can be either extended polystyrene (EPS), extruded polystyrene foam or polyurethane foam, etc. This project will conduct numerical simulations of both structural panels (i.e. Fibre cement skin SIP and OSB skin SIP) under windborne debris impact by using commercial code LS-DYNA. Influences of various parameters such as debris mass and geometry, debris impact velocity, impact location, as well as panel material, dimension and boundary condition on panel performance under debris impact will be analyzed. Vulnerability curves and fragility curves will be built by conducting numerical simulations. Some simple analytical approaches will also be developed to predict the panel penetration-resistant capacity to windborne debris impact. Two students will be involved in this sub-project.

Winthrop Professor Liang Cheng: Supervisor (3 Projects)
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**Topic 1:** Coastal and offshore erosion and prevention measures  
*Discipline: Civil Engineering*  
*Suitable for 3-4 students*

**Topic 2:** Hydrodynamic stability of offshore structures  
*Discipline: Civil Engineering*  
*Suitable for 3-4 students*

**Topic 3:** Numerical modelling of flow/structure interactions  
*Discipline: Civil Engineering*  
*Suitable for 3-4 students*

Asst/Professor Daniela Ciancio: Supervisor (3 Projects)
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**Topic 1:** Experimental and numerical investigation of the mechanical and structural behaviour cement-stabilised rammed earth  
*Discipline: Solid Mechanics, Structural Analysis and Geotechnical Engineering*  
*Suitable for up to 4 students*

**Co-Supervisors:** Doctor Chris Beckett

**Topic 2:** Mini notched round determinate panel – an innovative experimental procedure for fibre-reinforced shotcrete  
*Discipline: Solid Mechanics, Structural Analysis and Fracture Mechanics*  
*Suitable for up to 4 students*

**Topic 3:** Zero-thickness interface elements  
*Discipline: Finite Element Analysis, Fracture Mechanics*  
*Suitable for up to 4 students*
Assistant Professor James Doherty: Supervisor (3 Projects)

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**Topic 1: Development of Web based civil engineering software applications**

*Discipline: Computer Science and Software Engineering*

*Suitable for 2-3 computer science students or any student with strong programming skills and an interest in web programming.*

The aim of this project will be to investigate web technologies for hosting civil engineering software applications. To begin with, the benefits of various web technologies will be investigated. This will involve reviewing various application requirements and compare these with features in technologies such as PHP, MySQL for building dynamic web sites, or SOAPS for calling server hosted function through excel. Simple example functions will provide to test the different approaches. Once a particular approach is selected, a more complex geotechnical web application will be programmed.

**Topic 2: Experimental investigation into the mechanical behavior of mine backfill**

*Discipline: Civil Engineering*

*Suitable for 2-3 with a strong interest in soil mechanics and geotechnical engineering*

Underground mining creates large voids known as stopes. To ensure regional stability of the mine, stopes are backfilled with a mixture of tailings (waste from ore processing) and cement. Water is added to the material to achieve a slurry-like consistency to aid transport to the stope via a reticulation system.

Two key questions that arise at all backfilling operation are

- How much cement must be added to the backfill?
- How fast can the stopes be filled?

Obtaining accurate answers to these questions has a significant economic impact on virtually all underground mines in Australia. To properly address these questions, the mechanical (and chemical) properties of mine backfill must be clearly understood. The aim of this project will be to undertake laboratory studies on backfill samples from Australian mine sites.

**Topic 3: The settlement of shallow foundations on sand**

*Discipline: Civil Engineering*

*Suitable for 2-3 with a strong interest in soil mechanics and geotechnical engineering*

Serviceability criteria govern the design of most geotechnical structures. Despite this, predicting ground movement in even very simple situations remains a challenge for geotechnical engineers. The aim of this project will be to conduct a range of experiments on the stress-strain and creep strain response of sands using advanced element testing, a newly developed UWA mini pressure meter, as well as developing new testing equipment that can measure the load displacement response of miniature footings.

Winthrop Professor Arcady Dyskin: Supervisor (3 Projects)

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**Topic 1: Computer modelling of crack growth in compression**

*Discipline: Civil and Mining Engineering*

*Multi-student project*

Failure of concrete, rock and rock masses is often caused by sudden crack propagation under the action of high compressive load. Proper understanding of crack growth in compression is therefore of paramount importance for the prediction of failure and the development of the methods of preserving the structures. Extensive experimental studies of this failure mechanism have cast some light on its basics but failed to provide comprehensive understanding because of significant difficulties in conducting precise fracture tests in such heterogeneous materials as rocks and concrete. With the advance of computer technologies, computer simulation and modelling is become a viable and cheap alternative to experimentation.
The main challenge in modelling of crack growth in compression is formulating the fracture mechanics criteria of crack propagation. To overcome this difficulty a direct finite element modelling with removal of failed elements is used. However such a modelling is suffered from mesh dependence: refining the mesh does not lead to stabilisation of the results. In order to overcome this difficulty, we will use the concept of scalable mesh whereas the computations are conducted with meshes of markedly different densities and the law governing the dependence of the length/direction of crack growth on the element size is derived.

The research aims at computer simulation of crack growth in compression using an ABAQUS Finite Element model. The following four projects are offered:

1.1 2D modelling of crack growth from an inclined shear crack
1.2 2D modelling of crack growth from an inclined open crack
1.3 3D modelling of crack growth from a spherical pore
1.4 2D modelling of crack growth from a pore towards an interface

Topic 2: Structures based on topological interlocking blocks

Discipline: Civil Engineering
Multi-student project

The projects from this group form a part of a large ongoing project focused at developing novel methods in Structural Engineering. This is based on topological interlocking building blocks/bricks, which are the blocks that due to the specifics of their geometry can form self-holding assemblies. Different smooth block shapes have been discovered that allow the interlocking without the aid of keys or connectors. Thus the blocks are produced that can hold together without adhesive, which leads to a range of possible civil engineering applications from demountable structures and pavements (e.g. for air fields) to seismic-proof foundations and can cast a light on the astonishing longevity of ancient dry stone structures.

2.1 Method of producing uniform concrete/microconcrete interlocking blocks
The aim of the project is to find the concrete mixes, which ensure uniformity of the block and proper quality of its surface. The uniformity will be measured by performing indentation tests at different parts of the block.

2.2 Investigating bearing capacity of columns made of topological interlocking blocks
The aim of this experimental project is to conduct comparative analysis of the uniaxial compressive strength of the topological interlocking column as compared to the column built from rectangular blocks with and without mortar and a solid column.

2.3 Numerical modelling of bearing capacity of columns made of topological interlocking blocks
The aim of this numerical project is the same as the previous project but with computer simulations using a finite element code (ABAQUS)

2.4 Mechanics of interlocking and analysis of mortarless historical structures based on the principal of topological interlocking.

The aim of the project is to develop a theory of topological interlocking and investigate where in the historical mortarless structures the principle of interlocking is used (explicitly or implicitly)

Topic 3: Rock Properties in 3D

Discipline: Mining Engineering
Multi-student project

Co-Supervisor: Winthrop Professor Phil Dight (UWA)
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Recent work conducted at UWA has shown that many intact rocks exhibit anisotropic strength and deformation behaviour in the pre-peak and post peak stress strain testing. The research has also demonstrated that intact rock can retain memory of the loads to stress to which it has been subjected in situ. This is called Rock Memory, and has been used to determine the current state of stress in and around mineralised systems. The research postulates that the memory is associated with the grains in the rock. The question arises as to whether the memory is retained if the same rock was heated to a temperature that the rock becomes micro-fractured.

The use of heat to induce micro-fracturing in rock mechanics and its effect on the rock response in triaxial tests was utilised to formulate the first of the “rock mass responses” in the late 1960’s. This work became the impetus for the currently popular GSI method of determining rock mass behaviour (the GSI method). The GSI method assumes isotropic and homogeneous behaviour and largely ignores the post-peak behaviour. This work did not look at the 3D effects of the rock.
The research proposed in this project is multifaceted and would look at the intact and fractured rock behaviour of several rock types in 3D.

The project offers the following subprojects:

3.1 **Characterisation of heat-induced microcracking**
The project involves heat treatment of rock samples, producing microcracking, comparing the wave velocities, recounting the change in the microcrack concentration due to heating and comparing it with micrographs of the rocks before and after heating.

3.2 **Similarity of fracture patterns at different scales**

3.3 **Effect of heating on rock memory**
The project involves measuring the rock memory using the Kaiser effect and DRA before and after heating and determining the effect of heating.

3.4 **Rock anisotropy and its effect on stress measurements using the overcoring method**
This project involves numerical simulation of in situ stress measurements.

3.5 **Peak and Post Peak behaviour of intact and fractured rocks**
This project would examine the stress strain response of the intact and microfractured samples unconfined and confined to evaluate the change in response.

**Professor Richard Durham: Supervisor (6 Projects)**

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Please note that usually at least 50% of Mining Engineering students get their thesis topics from industry whilst on vacation work.

Also this list is a dynamic one; it will change - particularly with possible follow-up projects to theses that finish in November and June each year.

**Topic 1: Eliminating the use of diesel underground**

*Discipline: Mining Engineering*
*Multi-student project*

The WHO has recently defined diesel fumes as carcinogenic, so underground mining operations need to consider how to totally eliminate the exposure of personnel to them.

**Topic 2: Simulation of truck haulage operation and maintenance strategies**

*Discipline: Mining Engineering*
*Multi-student project*

To date, mining engineers have performed simulations of truck haulage systems, and maintenance engineers have done simulation of workshops. But these simulations tend to have been done totally independently. A complete simulation of a truck/loader fleet, together with various maintenance strategies (e.g. perform regular preventative maintenance, let the equipment work until it fails, put priorities on different equipment) needs to be constructed in a tool such as Arena.

**Topic 3: Particle size analysis software**

*Discipline: Mining Engineering*
*Multi-student project*

Many projects, especially those involving blasting, require the accurate analysis of the size distribution of a large sample of rock (e.g. a muck pile). They are several software packages on the market that claim to perform this accurately. A rigorous analysis of these is required.

**Topic 4: Rolling resistance**

*Discipline: Mining Engineering*
*Multi-student project*
Haulage is a major cost of most open pit operations, and its cost is highly dependent on the Rolling Resistance (RR) of the roads. An analysis of methods to measure, or empirically estimate RR accurately is required.

**Topic 5: 3D stereo-nets**

*Discipline: Mining Engineering*

*Single student project*

The classical stereo-net used in rock mechanics is a projection of a sphere (either equal angle or equal area) onto a 2D piece of paper, similar to the manner in which maps represent the earth’s surface. This is a necessary inaccuracy caused by the absence of the ability to view the data in its true 3D. However, nowadays with 3D software, it should be possible to reproduce all the mathematics of stereo-nets in a true 3D environment. Datamine software has had the ability to display rock mechanics data in a 3D display for years, but without the necessary analysis tools.

**Topic 6: Subsea mining of flooded open pits**

*Discipline: Mining Engineering*

*Multi-student project*

Technology to mine under water is established for soft material (e.g. dredging) and is becoming better at harder rocks (subsea mining). Is it possible to use such an approach to extract another bench or so from “mined-out” open pits, usually now flooded?

**Winthrop Professor Andy Fourie: Supervisor (4 Projects)**

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**Topic 1: Consolidation of Mine Tailings**

*Discipline: Civil and Environmental Engineering*

*Suitable for up to 4 students*

*Ideally at least one student should be a Civil major, and at least one an Environmental major.*

**Co-Supervisor: Winthrop Professor Carolyn Oldham (UWA)**

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Tailings are the waste material (typically sand sized and smaller) left after processing mine ore. Management of tailings requires safe storage in secure impoundments. Recent work at UWA has highlighted particularly anomalous behaviour of some tailings originating from the Goldfields of WA. This project will: a) Design an experiment to investigate the anomalous behaviour, which is particularly prevalent during consolidation tests; b) use appropriate software to study possible chemical interactions that might explain the observed effects, and c) use techniques such as SEM to back up and support the experimental and modelling study.

**Topic 2: Geotechnics of super soft sediments**

*Discipline: Civil or Environmental majors.*

*Suitable for up to four students.*

There are a range of materials (clay tailings in a thickener, dredged material, etc.) that have very low strengths due to the low effective stress they are subject to. For these materials, inter-particle effects such as surface charge can be important. This project will: a) Investigate how the addition of synthetic flocculants changes the geotechnical behaviour of various clays, b) Develop a method of producing consistent quality mixes, c) Use a new gravity thickener model to investigate evolution of density profiles, and d) Trial novel techniques for detecting the boundary between fluid and sediment.

**Topic 3: Improving farm yields through the application of geotechnical engineering principles**

*Discipline: Civil, Mechanical or Environmental majors.*

*Suitable for up to four students.*
Farmers in WA are amongst the most technologically adventurous in the world. However, interpretation of the results they obtain from field trials (ripping, seeding, etc.) lack a fundamental framework for interpreting and extrapolating the results. This project will: a) Test soils from four farms in WA, including compaction tests, water retention tests and permeability tests, b) Conduct field tests at the same farms to measure in-situ properties such as permeability, before and after various treatments are applied, and c) Develop some preliminary guidelines for farmers on the impact of vehicle traffic on the soil profile, and potentially on crop yield.

**Topic 4: Reducing the cost of Cemented Paste Backfill**  
*Discipline: Mining Engineering majors.*  
*Suitable for up to four students.*  

**Co-Supervisor: Doctor Alsidqi Hasan (UWA)**  
Cemented paste backfill (CPB) is increasingly being used in Australian mines, providing improved ore recovery and local ground support. This project will: a) Require an extensive program of laboratory tests to characterise the engineering behaviour of a selected CPB material, b) Evaluate the suitability of current design methods for CPB, c) Design a system for non-destructive measurement of CPB quality in-situ.

**Associate Professor Anas Ghadouani: Supervisor (2 Projects)**  
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**Topic 1: Improving the efficiency of waste stabilisation ponds**  
*Discipline: Environmental Engineering*  
*Suitable for 4 students*  

**Co-Supervisor: Asst/Professor Elke Reichwaldt**

**Topic 2: Hydrodynamcis of waste stabilisation ponds**  
*Discipline: Environmental Engineering*  
*Suitable for 2 students*  

**Co-Supervisor: Assoc/Professor Marco Ghisalberti**

**Winthrop Professor Hong Hao: Supervisor (3 Projects)**  
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**Topic 1: Development of Segmented Structural Columns to Resist Multi (Earthquake and Blast) Hazards**  
*Discipline: Civil Engineering, Structural Engineering*  
*Suitable for 4 students*  

Owing to different characteristics of air blast pressure and earthquake ground excitation, structural responses and damage mechanism to blast and earthquake loads are very different. For example increasing structural mass is beneficial in blast resistant design because of the increased inertial resistance, whereas increasing structural mass increases seismic loads acting on the structure therefore should be avoided in earthquake-resistant design. Similarly because of the different response and damage mechanisms, the commonly used displacement-based design criteria such as the ductility ratio and interstorey drift cannot be applied to assess the structural performance subjected to blast loading. Under blast loading, structure is likely to experience brittle local failure such that structural collapse might occur before the structure experiences any large displacement responses.

In this project, the effectiveness of a segmented structural column in resisting both earthquake ground excitation and blast load will be investigated. Study of using free-standing columns or bridge piers, i.e., to allow structural foundation to rock underground excitations has been intensively investigated recently. It has been found that using rocking foundation increases structural displacement responses but is effective to protect the structure as it reduces the shear force and bending moment in the structural column. Study of using segmented structural column to resist...
earthquake ground motions and blast loads is limited. In this project, both experimental tests and numerical simulations will be conducted to investigate the effectiveness of using segmented structural columns to resist both earthquake ground excitations and blast loads. Four students are needed to work on this project.

**Topic 2: Wind Tunnel Tests and Numerical Simulations of Wind Pressure Distributions inside Building Structures with or without Opening**
*Discipline: Civil Engineering, Structural Engineering*
*Suitable for 3 students*

**Co-Supervisor: Professor Tongming Zhou (UWA)**
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With climate change the wind speeds in many areas keep on increasing. For example, a study conducted by CSIRO in 2011 concluded that ‘the average wind speed measured 10m above the ground had increased by about 0.7 per cent per year since 1975’. In region D defined in the Australian Wind Loading Code, the design wind speed is up to 110 m/s. Under such a high wind speed, the windborne debris could impact on structural envelope (panels, roofs and windows) at a speed of 44 m/s. Most common window glass and structural panels currently used in construction industry could not resist such a high-speed impact. If a structural envelope is impacted, the windborne debris is likely to create an opening on the structural envelop. Such openings allow wind pressure propagating into the room and generate internal pressure, which may result in roof lifting up, panel collapse and total structural failure. For example, after the 1974 cyclone Tracy, the post event investigation conducted by Walker concluded that one of the most remarkable factors contributing to the wide scale overturning and damage of housing was the overwhelming internal pressure following the windows and cladding failure due to windborne debris impact.

In this project, both wind tunnel test and numerical simulations will be conducted to investigate the internal pressure distributions inside residual house models of different dimension, geometry and with or without openings. The results can be used to assess the structural safety under extreme wind conditions.

The project will be jointly supervised with Prof. Tongming Zhou. Three students are needed for this project.

**Topic 3: Development of a Layered Pipe for Vibration Control**
*Discipline: Civil Engineering, Structural Engineering*
*Suitable for 3 students*

Pipeline network is usually considered as lifeline structures because damage of pipeline structures could be catastrophic. A number of sources may cause damage to pipelines including corrosion, fatigue, earthquake and accidental explosions, etc. Among those sources, damages related to fatigue, earthquake and explosion are all associated with pipeline vibrations. Therefore it is important to control pipeline vibrations to reduce the possibility of catastrophic damage.

In structural vibration resistance design, three types of controls can be used, namely, active, semi-active and passive controls. Various devices and algorithms related to these vibration controls have been developed and applied to structures. In this project, an innovative passive control design to reduce pipeline vibration will be explored. The design will be based on tuned mass concept used in building and bridge structures to reduce vibrations during earthquakes. The project will involve theoretical and analytical derivations, numerical simulations, and experimental tests. Three students are needed for this project.

**Doctor Yi Fei Hao (Research Associate): Supervisor (1 Project)**
*yifei.hao@uwa.edu.au*

**Project name: Laboratory tests of spiral-shaped steel fibre pull-out behaviour from concrete**
*Discipline: Civil Engineering*
*Suitable for 4 students*

Four students are needed to work on this project. All students will work together for the specimen preparation, but each will concentrate on different aspects, i.e., 1) static and dynamic pull-out tests on straight, hooked-end and spiral fibres, 2) static pull-out tests on spiral fibres with different specifications, 3) dynamic pull-out tests on spiral
fibres with different specifications, and 4) static and dynamic tests on the material properties of plain concrete and SFRC reinforced with different fibres under compression and tension.

Adding short discrete steel fibres into concrete mixture has been widely studied and applied in construction of high-rise and long-span structures. It has been proven that the dispersive steel fibres, as reinforcements, are able to significantly increase the post-peak load bearing capacity of the concrete mixture. Laboratory tests carried out in past few years on spiral-shaped steel fibre reinforced concrete (SFRC) cylinder specimens and beams indicated the superiority of using spiral shaped steel fibres in reinforcing concrete materials as compared to other fibre types. However, the mechanism of spiral fibres in SFRC is not well understood yet. Studying the pull-out behaviour of a single fibre from the concrete matrix is the key to fundamental knowledge of SFRC materials and structures subjected to static and dynamic loads.

In this project, laboratory tests will be conducted to study the behaviour of single fibre pull-out from concrete mixture. Different types of fibres, e.g. straight, hooked-end and spiral, will be tested with consideration of different embedment depths and embedment angles. A series of tests will also be carried out considering geometry variations of spiral fibre to find out the optimum specification. The fibre pull-out tests will be split into static and dynamic parts. Moreover, cylindrical specimens made of plain concrete and SFRC with different types of fibres will be tested under static and dynamic loads, under compression and tension, respectively to derive the material properties.

Professor Yuxia Hu: Supervisor (3 Projects)
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Topic 1: Offshore Foundation with Large Movement on Offshore Deposits
Discipline: Offshore Geotechnical Engineering
Multi-student project

Topic 2: Pavement Design in WA
Discipline: Pavement Engineering
Multi-student project

Topic 3: Foundation Settlement on Different Soils
Discipline: Geotechnical Engineering

Multi-student project

Associate Professor Nicole Jones: Supervisor (1 Project)
nicole.jones@uwa.edu.au

Topic 1: Oceanography of the coastal Kimberley
Relevant discipline(s) Oceanography, Fluid Mechanics, Time Series and Spatial Data Analysis.
Suitable for 3 – 4 students

Assistant Professor Mehrdad Kimiaei: Supervisor (1 Project)
mehrdad.kimiaei@uwa.edu.au

Topic 1: Probabilistic analysis of offshore platforms under extreme environmental loads
Relevant discipline: Offshore Engineering.
Suitable for 2-3 students interested in offshore structural engineering and have completed CIVL3170 (and preferably CIVL4170).
This project involves numerical work and students will learn how to apply wave (or seismic) loads probabilistically on offshore platforms.

**Doctor Raj Kurup Environmental Engineers International Pty Ltd: Supervisor: (3 Projects)**
raj.kurup@uwa.edu.au

Please note that before the projects are allocated to students, an IP agreement is to be signed between Environmental Engineers International Pty Ltd and UWA.

**Topic 1:** Mineral processing industry by-products for nutrient removal  
*Discipline: Environmental, Civil, Chemical & Mechanical  
Suitable for 3 students*

**Co-Supervisor: Winthrop Professor Keith Smettem**  
keith.smettem@uwa.edu.au

**Topic 2:** Evaluation of guidelines, standards and policies for water recycling projects in Western Australia  
*Discipline: Environmental, Civil, Chemical  
Suitable for 2 students*

**Topic 3:** Alternative bed media using industrial by-products for constructed wetland wastewater treatment systems  
*Discipline: Environmental, Civil, Chemical & Mechanical  
Suitable for 3 students*

**Co-Supervisor: Winthrop Professor Keith Smettem**  
keith.smettem@uwa.edu.au

**Winthrop Professor Barry Lehane: Supervisor (3 Projects)**
barry.lehane@uwa.edu.au

**Topic 1:** Design correlations for pile design  
*Discipline: Geotechnical Engineering  
Multi student project*

**Topic 2:** Characterisation of the soils in Australian oil and gas fields  
*Discipline: Geotechnical Engineering  
Multi student project*

**Topic 3:** Long term behaviour of shallow foundations  
*Discipline: Geotechnical Engineering  
Multi student project*

**Research Associate Doctor Jun Li: Supervisor (1 Project)**
jun.li@uwa.edu.au
Office: ECM B1.48
Topic 1: Application of a Relative Displacement Sensor for Structural Health Monitoring of Civil Structures
Discipline: Civil Engineering, Structural Engineering
Suitable for 3-4 students

1.1. Application of a Relative Displacement Sensor for Condition Monitoring of Joints in Frame/Truss Structures
1.2. Signal Processing with Relative Displacement Measurements for Structural Health Monitoring
1.3. Development of an Energy Harvesting Strategy from structural vibrations to Supply the Sensor Power
1.4. Wireless Communication of the Sensor and Embedded Data Processing to Indicate Structural Behaviour and performance

Winthrop Professor Carolyn Oldham: Supervisor (5 Projects)
carolyn.oldham@uwa.edu.au

Topic 1: Water sensitive urban design (WSUD) in areas with significant groundwater – surface water interactions.
Discipline: Environmental Engineering Majors
Suitable for 4 students
Students will be involved in the Cooperative Research Centre (CRC) for Water Sensitive Cities.

Co-Supervisors: from Monash, Griffith and Queensland Universities.
High groundwater tables across the Swan Coastal Plain rise under urbanization, constraining development options as well as impacting on ecosystem health. These inter-disciplinary projects will explore a) the interaction between geomorphology, sediment transport and WSUD elements, b) changing landscape connectivity under urbanization, c) seasonal variation of water budget for sub-surface drainage and filtration basins used for management of high groundwater tables and d) how we link engineering technical understanding of urban development to planning and regulatory frameworks.

Topic 2: Transport of seagrass wrack on and off WA beaches.
Discipline: Environmental and Civil Engineering Majors
Suitable for 4 students

Co-Supervisors: Winthrop Professor Andy Fourie (UWA); Professor Paul Lavery (ECU) and Doctor Graham Symonds (CSRIO).
Seagrass wrack accumulation on WA beaches has a significant impact on coastal infrastructure and public amenity. Yet we have little capacity to predict how wrack arrive on beaches and when/how it is removed. These inter-disciplinary projects will explore a) the compaction of wrack piles over a season using field and laboratory studies; b) the erodibility of the wrack piles as a function of compaction, using laboratory studies; c) analysis of photographs and video images of the of stranding and removal of wrack on and off beaches; d) the parameterization and modelling of seagrass wrack on and off beaches.

Topic 3: Effectiveness of oxygen injection for prevention of hydrogen sulfide accumulation in Water Corporation pipes.
Discipline: Environmental and Chemical Majors
CEED Project (Selection process underway) - 1 student

Co-Supervisors: Esther Loh and Johan Salim (Water Corporation).
The Water Corporation has an extensive network of pipes that deliver water and industrial water to treatment plants. Oxygen gas injection is used along the pipe network to minimize accumulation of hydrogen sulfide gas. This project will review the effectiveness of the current operations, and compare with international best practice.

**Topic 4: Pressure affects on calibration of underwater stereo video cameras.**

*Industry Project*

1 student – Selection process complete – Nadar Boutros (SN20504105)

**Co-Supervisors:** Doctor Jim Seager (SEAGIS: the main hardware and software provider); Professor Mark Shortis (RMIT); Euan Harvey (Plant Biology, UWA).

Underwater stereo-video systems allow measurement of fish communities, including their size distributions, with very high precision. However, the stereo-video optics are affected by water depth i.e. pressure, that may deform housings and ports, affecting subsequent measurement. This project would involve calibration of the camera at different depths using two different calibration methodologies, and statistically comparing the differences in accuracy and precision, robustness of the calibration strategy and time involved.

**Topic 5: Consolidation of mine tailings**

*Discipline: Environmental and Civil Engineering Majors*

Suitable for 4 students – Ideally at least one student should be a Civil major, and at least one an Environmental major.

**Co-Supervisors:** Winthrop Professor Andy Fourie (UWA)

andy.fourie@uwa.edu.au

See Scope under W/Prof Andy Fourie project list

**Winthrop Professor Charitha Pattiaratchi: Supervisor (1 Project)**

chari.pattiaratchi@uwa.edu.au

**Topic 1: Coastal sediment transport and stability along the Perth Metropolitan region**

*Discipline: Civil and Environmental Engineering*

*Multi student project*

**Co-Supervisor:** Asst/Professor Sarath Wijeratne (UWA)

sarath.wijeratne@uwa.edu.au

The development and maintenance of coastal infrastructure requires an understanding of coastal processes and the interaction of these processes with the beach. Varying wind, waves, currents and water levels facilitate transport of sediment within the nearshore coastal zone leading to areas of sediment loss (erosion) and accumulation (accretion). Coastal protection methods are often implemented to moderate the impacts of coastal erosion and accretion and are often required as a means of maintaining the structural integrity of nearshore developments. Recent storms in 2012 and 2013 have resulted in erosion in sections of the Perth Metropolitan coast with many examples highlighted in the local press. These include: South beach and Port Beach in Fremantle; Watermans Bay; and, Quinns Rock.

This project, which can accommodate a group of students, will initially review the coastal processes causing coastal erosion along the Perth Metropolitan region through both literature search and data analysis. This will also include the different coastal protection strategies which may be employed at these sites. At the second stage, an existing computer model simulating the effects of nearshore waves, currents, water levels and sediment dynamics will be developed for each of these sites to assist in developing and testing different protection strategies to mitigate coastal erosion at each of these sites.
Asst/Professor Elke Reichwaldt: Supervisor (1 Project)

Topic 1: Environmental risks of natural and engineered (WSP) water waterbodies
Discipline: Environmental Engineering
Suitable for 2 students

Co-Supervisor: Associate Professor Anas Ghadouani

Winthrop Professor Keith Smettem: Supervisor (3 Projects)
keith.smettem@uwa.edu.au

Topic 1: Developing a hydrologic understanding of the Pilbara and Gascoyne regions.
Discipline: Civil and Environmental Engineering
Multi student project

Topic 2: Vortex-induced dispersion to chemical transport in channels.
Discipline: Civil and Environmental Engineering
Multi student project

Topic 3: Design of an artificial wetland for nutrient removal at the University Farm
Discipline: Chemical Engineering
Multi student project

Asst/Professor Yinghui Tian (COFS): Supervisor (1 Project)
yinghui.tian@uwa.edu.au

Topic 1: Numerical investigation on the bearing capacity of shallow and deeply buried footings
Discipline: Offshore Engineering
Suitable for 2 students

With the depletion of shallow water oil and gas reservoirs, offshore engineering is moving into deep water, which challenges the geotechnical engineers to accurately predict the bearing capacity of various foundations, including shallow foundation like mudmat and deeply buried anchor.

Research Associate Cristina Vulpe: Supervisor (1 Project)
Cristina.vulpe@uwa.edu.au

Topic 1: Effect of consolidation on the combined capacity of shallow footings.
Numerical study
Discipline: Geotechnical Engineering, Offshore Engineering

Co-Supervisor: Professor Susan Gourvenec (UWA)
Susan.gourvenec@uwa.edu.au
Many offshore structures are in-service over a significant period of time; others are intentionally preloaded prior to service. The soft marine saturated clay on which these foundations are located undergoes changes with time: the excess pore water pressure, resulting from the applied load due to the foundation dead weight, dissipates and as a result the soil consolidates and its void ratio decreases. The direct effect of consolidation is an increase in soil strength and associated increase in bearing capacity. This additional capacity has not been quantified in the past leading to potential inefficiency in foundation designs.

The current project aims towards a comprehensive analysis of the effect of consolidation on the strength of soft clay. The ultimate goal of the project is to offer a simple design method that capitalizes on the extra capacity brought in by the consolidation of soil over time.

The effect of consolidation on shallow footings will be investigated by means of finite element analyses (FEA).

Winthrop Professor Anya Waite: Supervisor (5 Projects)
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Oceanography of the Eastern Indian Ocean

**Topic 1:** Controls of biogeochemical fluxes and climate links

*Discipline: Environmental Engineering*
*Multi student project*

**Co-Supervisor: Allison McInnes**

An ocean-going research voyage (July 15 – August 10th) on the new Australian research vessel, the RV Investigator, will be the platform for a project examining the role of nitrogen fluxes in controlling the ecology, particle dynamics and carbon cycle of the Eastern Indian Ocean. This will be a collaborative venture with scientists from Germany, Canada, and the US. Ship-board measurements may include ship-board culture experiments, sediment trap moorings, and deployment of electronic sampling gear, as well as satellite remote sensing.

**Topic 2:** Plankton Populations associated with Whalesharks at Ningaloo

*Discipline: Environmental Engineering*
*Multi student project*

**Co-Supervisor: Mark Meekan (AIMS)**

Plankton dynamics offshore of Ningaloo are likely to be important drivers of whaleshark ecology. A field-based project will investigate links between oceanography, zooplankton, and whaleshark ecology.

**Topic 3:** Understanding variation in of continuous Water Quality Monitors (WQMs) against pigments and phytoplankton measures from *in situ* sampling.

*Discipline: Environmental Engineering*
*Multi student project*

**Co-Supervisor: Tim Lynch (IMOS)**

**Topic 4:** Power comparisons of sampling strategies between historical monthly water sampling and modern 15 minute samples from sensors.

*Discipline: Environmental Engineering*
*Multi student project*

**Co-Supervisor: Tim Lynch (IMOS)**
IMOS data provide continuous data sets of pigments and phytoplankton designed to understand background variability for the purpose of tracking climate-driven changes. Here we investigate oceanographic processes impacting the quality of these data sets. We propose to analyse preliminary field data and undertake laboratory experiments. Field data to be analysed will come from temperate, sub-tropical and tropical Australia and temperate and sub-tropical USA coastal waters. Laboratory experiments will be undertaken with cultures provided by the CSIRO national algal reference collection. Calibration and Quality Assurance of NRS Wetlabs Water Quality Monitors (WQMs) will be tested against pigments and phytoplankton measures from in situ sampling.

**Topic 5: Biogeochemical modelling, from physics to a second trophic order, seasonal cycles in Australian coastal waters**

*Discipline: Environmental Engineering*

*Multi student project*

**Co-Supervisors: Tim Lynch (IMOS) and Peter Thompson (CSIRO)**

Recent climate trends in Australian coastal waters have the possibility of profoundly impacting the health and behaviour of higher trophic levels, particularly the plankton feeders. Here we will execute a multidisciplinary synthesis aiming to predict how seasonal cycles off Australia impact the planktivores (these include sardines, whalesharks and blue whales).

**Professor Tongming Zhou: Supervisor (3 Projects)**

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**Topic 1: Experimental investigation of aerodynamic loads on an overland causeway truss**

*Relevant Discipline: Civil Engineering/Offshore Engineering*

*Suitable for 3 students*

Overland causeway trusses are used to transport mining products from the site, which can be easily a few kilometres long. Therefore, aerodynamic loads on the trusses will be significant, especially under extreme weather conditions. Accurate estimation of these loads will be important for the design and safe operation of the trusses. In this project, truss models will be constructed and wind load on them will be measured under various flow conditions and for various model arrangements.

**Topic 2: Vortex shedding from a yawed bluff body with rectangular cross-section and its dependent on Reynolds numbers and inclination angles**

*Relevant Discipline: Civil Engineering/Offshore Engineering*

*Suitable for 3 students*

When a flow passes a structure of rectangular cross-section, separation occurs at the leading corners. Vortex will be shed alternatively and regularly from the separating points. The vortices shed from the bluff body will induce vibration of the structure and can result in excessive motion and possible structural failure. In the present project, experiments will be conducted in a wind tunnel to study the wake flow downstream of a bluff body with a rectangular cross-section at different yaw angles between the structure and the flow. Dependences of force coefficients, and vortex shedding frequency on Reynolds numbers and yaw angles will be studied and compared with that obtained in wakes of cross-flows.

**Topic 3: Experimental studies of passive control of vortex shedding from a circular cylinder**

*Relevant Discipline: Civil Engineering/Offshore Engineering*

*Suitable for 3 students*

Vortex shedding is a phenomenon that occurs when a flow passes a bluff body (e.g. a single or a group of tall chimneys, tall buildings, marine risers for oil production, mooring lines, deep-water structures such as the
pipelines). It is well known in the offshore community that the cylindrical bluff structures suffer from vortex-induced vibration (VIV) in strong current conditions. The marine risers, for example, also induce the flow around them to separate and initiate vortex shedding. These vortices cause extra dynamic forces and vibration to the risers. VIV should be avoided in engineering applications. This is because: (1) VIV will increase the fluid dynamic loading to the structures, (2) it will also influence the stability of the structures, (3) the vibration of the structures will accelerate the fatigue failure etc. The above factors will influence both the capital investment of the structures and the expenses for maintenance. Therefore, great effort has been devoted to the control of vortex shedding from a bluff body, both using active methods and passive methods. In the present project, vortex shedding will be controlled using screen meshes, which are attached outside the cylinder with various gaps. The objective of the project is to examine the effectiveness and mechanism of the control methods on VIV reduction.