School of Civil, Environmental & Mining Engineering

2014 – Honours & Masters Research Projects

Project Offerings

Water & Environmental | Structural | Architectural | Geotechnical | Mining

Honours
- C&ENVENG 4003A/B **Civil and Structural Research Project** Part 1 & 2
- C&ENVENG 4005A/B **Civil and Environmental Research Project** Part 1 & 2
- MINING 4100A/B **Mining Research Project** Part 1 & 2

Masters
- C&ENVENG 7049A/B **Masters Civil & Structural Eng Project** Part 1 & 2
- C&ENVENG 7050A/B **Masters Civil & Environmental Eng Project** Part 1 & 2
- MINING 7074A/B **Masters Mining Eng Project** Part 1 & 2

Course Coordinator: Bec Francis

CRITICAL INFORMATION

- **Application Form Deadline: 4pm Friday, November 8, 2013**
- **Applications Forms are available online and are to be submitted electronically**
- **Separate Application Forms required for Honours and Masters**
- **Only ONE Application Form is to be submitted per group**

NOTE: Honours Eligibility

Any student unlikely to be awarded an Honours degree (based on level 2 & 3 marks) will not be permitted to undertake a Research Project. These students will be notified by the Head of School after the examiners meeting and will be required to enroll in two additional final year specializations/electives instead of the Research Project.

Allocation

Allocation of research projects will commence following the examiners meeting (2013). Students will be advised in due course (likely to be late January 2014).

Once you have been allocated a Research Project, contact your Supervisor as soon as possible so that reading material can be provided and plans made for getting started on the project.

HOW TO MAKE YOUR APPLICATION

1. Project Offering Information
2. Application Form
   a. Part A: Group Selection
   b. Part B: Project Preferences
3. Frequently Asked Questions
4. The Research Projects

1 Project Offering Information

This document provides details of the Research Projects on offer to Honours and Masters students in 2014. Each project is identified to indicate whether it is on offer to Honours or Masters or both.

Each Research Project offering has an associated code number. The first letter of that code relates to the Discipline Area. These are as follows:

- **G** | Geotechnical
- **M** | Mining
- **S** | Structural & Architectural
- **W** | Water & Environmental

Depending upon your program of study, you are eligible to select from the following Discipline Areas:

- Civil & Environmental Engineering: ..... W & G
- Civil & Structural Engineering: .....W, S & G
- Architectural Engineering: ..... S & G
- Mining Engineering: .....G & M

Pages 4-5 contain a summary of all the Research Projects for 2014 and their project titles. This is followed by pages containing further detailed information on each Research Project, including:

- Whether it is available for Honours or Masters or both?
- Who is supervising?
- The project description
- Whether the research likely to involve, Computer Simulation, Lab work, Field work or Site visit(s)?
- Whether the project follows on from previous Research Project? And if so, when?

2 Application Form

There are separate Application Forms for Honours and Masters students; ensure you use the correct form for your level of study.

The Applications Forms are available online and are to be submitted electronically. Only ONE Application Form is to be submitted per group.

The deadline for online submission of your Application Form is: **4pm Friday, November 8**, 2013

2.1 Part A: Group Selection

The first section of the Application Form deals with identifying your group members.

Honours students are to self-select into groups of four (4).
Masters students are to self-select into groups of three (3).

In *exceptional circumstances* group of fewer students will be considered. Such groups will need approval from the Head of School.

Complete ALL the information requested for each member of your group.

2.2 Part B: Project Preferences

The second section of the Application Form deals with identifying your project preferences.

Each group indicates a minimum of five (5) projects in order of preference. You may list up to eight projects; #1 being your first preference to #8 being your eighth preference. Each Research Project offering has an associated code, eg. M08. Select this code on the Application Form.

Where more than one group wishes to undertake the same project, consideration will be given to the suitability of the group and the work load of academic, as well as the group's academic performance to date.

While your preferences are taken into consideration for allocation of your Research Project, they are not guaranteed. The ultimate decision on the group structure and research project rests with the School.

3 Frequently Asked Questions

Eligibility for 2014 Research Projects

- *How can Honours students determine if they are eligible for the 2014 Research Project? / What is the eligibility based on?*

To be eligible for Honours in your final year of study students need to obtain a weighted average of 60% for courses in Levels 2 and 3. The relative weightings of levels 2 and 3 courses will be factors of 2 and 3 respectively.

- *Can students who have completed 3 years of a 5 year undergraduate degree program do the project in their 4th year, or does it have to be in the last year of their degree?*

Yes, they can undertake the Research Project in their 4th year of study.

- *How are mid-year entry students impacted? Are they eligible to start at the beginning of the year?*

Provided the students have completed the course content in relation to the topic of research, it is possible for mid-year entry students to commence the Research Project at the start of the year.

Group size

- *Do all groups need to be four people or can there be smaller groups?*

Honours groups need to be four people; Masters groups need to be three people. With the permission of the Head of School exceptions to this might be possible, however due to the limitations on availability of academics, it is unlikely.

- *What happens if a group is chosen and then one or two students discover that they are not eligible for the project?*

Consideration will be given to merging the remaining students to form a suitable group. However this is not always practical.

- *How does the group selection process work?*

Students organise this themselves.

Assessment

- *Are all students in a group awarded the same grade?*

Not necessarily. There are some (minor) components that are graded individually (eg. oral presentation), and in addition there is the process of Peer Review which enables staff to moderate grades based on their own observations as well as peer recommendations of individual's contributions.

- *If one student in a group is eligible for 1st class honours and another student is eligible for 2nd class honours will the marking of the Research Project limit the ability of the 1st class honours student to achieve a high score?*

No.

Structure of the course

- *What needs to be produced?*

The requirements are likely to be the same as for 2013, which were:

Component	Honours	Masters
• Initial Research Report	25%	20%
• Initial Research Project Presentation	5%	5%
• Final Research Report	55%	60%
• Final Research Conference Paper	5%	10%
• Final Conference Presentation	10%	5%

- *Is there an exam?*

No.

- *How long does it (the whole course) run?*

Two consecutive semesters.

- *What time commitment is expected?*

The workload will be the equivalent time for a 3-units course in one semester, for both semesters in which you carry out the Research Project. According to university policy, this corresponds to 12 hours a week for the average student to achieve a credit.

Choosing a topic

- *Should the selected Research Project match specialization courses?*

Usually.

- *I'm interested in …… how do I find out what software will be used and/or more about the project?*

Ask the supervisor responsible for the project.

- *Is it important to fully understand the concept of the topic of the research project before we choose to do it?*

Not necessarily – many students discover that the literature review that takes place in the first semester of the Research Project moves their Research Project in a new direction, and often the project titles change depending upon the research process. This is perfectly fine!

How to excel in the project

- *What makes a good project*

Enthusiastic and committed students who start early!

Submitting the online Application Form

- *Who should it be emailed to?*

Upon clicking the 'SUBMIT' button the form will be automatically addressed to rebecca.francis@adelaide.edu.au, and this is the correct address.

- *Who should I contact if I have a problem?*

Send an email to the current Coordinator, Bec Francis at: rebecca.francis@adelaide.edu.au.

Further

In addition to the above, a video recording will be available of the special lecture **'2014 Final Year Research Project Selections'** (Thursday October 31, 2013). This lecture includes explanation of the process and the projects, who is eligible, and how you go about applying, and answers to questions from the student audience.

4 The Research Projects

NOTE: This is the order in which the projects appear in this booklet.

CODE	PROJECT TITLE
W01	Real-time control of pump operation under transient conditions
W02	Efficient simulator for water quality analysis in pipe networks
W03	Characterising uncertainty in pipeline hydraulic surge analysis
W04	Performance characterisation of the Ecosol Cartridge Filter
W05	Incorporation of Domain Knowledge into the Optimisation of Water Distribution Systems using Ant Colony Algorithms
W06	Simulation and Optimisation of Multiple Aquifer Stormwater Harvesting Schemes
W07	Pipe Condition Assessment using Fluid Transients
W08	Reducing the Risk of Discolouration Events in Water Distribution Systems - Monitoring and Prevention
W09	The Impact of Iron forming Bacteria Biofilm Development on Pipe Roughness and System Performance
W10	Pipe Condition Assessment using Acoustic Methods
W11	Development of a Benchtop Numerical Model Long Timeframe Simulator for Water Distribution Systems
W12	Securing water supply under a changing climate – a case study in Vietnam
W13	An Economic Cost-Benefit Analysis of Flood Hazards under Historical and Future Climates
W14	Non-Invasive Pipe Condition Assessment Using Water Hammer Transients
W15	Evolutionary Algorithm Optimisation of Design and Operation of Water Networks for Multiple Objectives Including Economic Cost and GHG Emissions

CODE	PROJECT TITLE
S01	Dynamic analysis of steel tubar confined concrete columns against blasts
S02	Shear response analysis of steel fibre concrete members against blast loads
S03	Protection of RC Structures against blast loading
S04	Dynamic analysis of ultra high performance concrete columns against blasts
S05	Finite element formulation for concrete cracking
S06	Formulation and modelling of reinforced concrete beam finite elements
S07	Numerical study of fracture properties of concrete
S08	Finite element analysis of steel concrete composite beams
S09	Interaction of different buckling modes in steel structural members
S10	Modelling of ultra high performance concrete structural members
S11	Structural behaviour of long span bridges
S12	Structural behaviour of Ultra-High Performance Concrete (UHPC)
S13	The influence of reinforcement corrosion on the long term deflection of RC beams.
S14	A design based approach for predicting long term deflections in reinforced concrete
S15	The development of geopolymer structural concrete
S16	Investigation into the effect of the microstructure on the performance of concrete
S17	The response of structures and components to blast loading
S18	The response of structural components to resist fragments and impact
S19	Investigation into the strain rate dependent behaviour of concrete
S20	Design and manufacture of ultra high-performance composite concrete columns
S21	Strength and ductility of concrete confined by advanced composite systems
S22	Design of concrete-filled composite tubes as earthquake-resistant columns for new construction
S23	Behaviour and design of FRP anchors
S24	Geopolymer concretes: Concrete goes green
S25	Solar Decathlon 2014
S26	Seismic retrofit/strengthening of unreinforced masonry walls for out-of-plane bending
S27	Improved assessment of out-of-plane seismic response of masonry walls

CODE	PROJECT TITLE
S28	Improving understanding of high frequency vibration techniques for safety inspection of structures
S29	Development of a practical safety inspection technique using high frequency vibration of structures
G01	Hydraulic conductivity of partially saturated soils
G02	Stabilisation of expansive soils with tyre crumbs
G03	Designing footings and retaining structures in unsaturated clay soils
G04	Quantifying the effectiveness of the 4-sided Impact Roller
G05	Numerical analysis on PVD-surcharge preloading combined consolidation
G06	Formulation for coupling fluid flow and cracking in rocks and concrete
G07	Modelling geofibres based composite geomaterials
G08	Developing a Multiple-step Loading Triaxial Compression Testing Method for Very Hard Rocks
M01	Rock fatigue damage evaluation under cyclic loading using Acoustic Emission
M02	Investigating the point of inflexion in Kaiser Effect for better estimation of in-situ stresses for various rocks
M03	Study on Application of Coal Mine Roof Rating (CMRR) Classification System to Design Support Systems in Underground Coal Mines
M04	Progressive Damage Mechanism of Rocks subjected to cyclic loading
M05	Simulation and Animation of an Australian Surface Mine
M06	Simulation and Animation of an Australian Underground Mine
M07	Use of SXL Simulation Language for Modelling and Australian Mine
M08	Developing a Drillability Model to Predict Drilling Penetration Rate in Different Drilling Situations
M09	Investigation into factors affecting the application of monorail systems in metalliferous mining in Australia
M10	A comparative study of computer simulation methods for haulage simulation in open pit mining
M11	Optimum Number of Passes – An aid to initial analysis and preliminary load and haul equipment selection
M12	Allocation and control of the mining truck fleet using dynamic programming
M13	DEM- Simulation of ore transfer points in a block caving mining system

Project Code: W01 Offered to: Honours & Masters
Primary Supervisor: Aaron C. Zecchin
Project Title: **Real-time control of pump operation under transient conditions**

Industry Partner: Eelko van der Vaart, Director of One Stone Consulting

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work: .....No
- Site visit(s):.....No

Does the project follow on from a previous year?..... No | N/A

Research Project Description:

Pumping stations form an integral component of many modern water transmission systems, where their typical objective is to add additional head to the flow to transport water over long distances through transmission mains, or to high elevation sources such as tanks. Increasingly, variable speed pumping stations are also used within the distribution network with the objective of maintaining sufficient network pressures, or delivering a specified flow rate to meet projected demand. In this latter case, the variable speed pumps need to be controlled in real-time to ensure that the design requirements of pressure and flow are being achieved. This situation is complicated by the fact that the demands within a distribution network continuously vary randomly with time, meaning that the pump speed will need to be controlled to cater to these changing hydraulic conditions.

The focus of this research project will be on the real-time control of a variable speed pump subject to changing hydraulic conditions. To undertake these investigations, a simple pipe-pump-pipe hydraulic system with time-varying boundary conditions will be initially considered. The proportional-integral-derivative (PID) controller will be investigated to control the pump speed to achieve a target flow or pressure using feedback. This project will also be co-supervised by Mr. Eelko van der Vaart, Director of One Stone Consulting.

Project Code: W02 Offered to: Honours & Masters
Primary Supervisor: Aaron C. Zecchin
Project Title: **Efficient simulator for water quality analysis in pipe networks**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work:.....No
- Site visit(s):.....No

Does the project follow on from a previous year? .....No | N/A

Research Project Description:

Many pipeline distributions networks transporting potable water to consumers use chemical protection within the water (e.g. chlorine) to inhibit the growth of pathogens within the system. To ensure that the system is sufficiently protected, the concentration of the chemical agent must remain above a specified threshold concentration throughout the network. However, many of these chemical agents decay with time, hence it is critical to undertake a water quality analysis of the distribution system to determine the required dosage concentrations. The water quality analysis considers the advective transport of the chemical constituent as it travels throughout the network, and the reactive decay of the chemical concentration with time. Many different types of water quality simulators exist, based on either a Lagrangian or a Eulerian framework for solving the advective-reactive (AR) transport equations. These methods require computation of the concentration values within the pipes, either through parcel tracking (i.e. Lagrangian), or a spatial discretization (i.e. Eulerian).

Recently a new and novel method has been developed that requires only computation of the concentration values at the nodes within the network. However, this method was derived only for the case of constant nodal demands and steady-state flow. This research project will involve the extension of the efficient node-based water quality simulation strategy to the case of extended period simulation where time varying demands and pipe flows will be considered.

Project Code: W03 Offered to: Honours & Masters
Primary Supervisor: Aaron C. Zecchin
Project Title: **Characterising uncertainty in pipeline hydraulic surge analysis**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work: .....No
- Site visit(s):.....No

Does the project follow on from a previous year?..... No | N/A

Research Project Description:

A hydraulic surge event (also termed "water hammer") is caused within a pipeline network when there is an abrupt change to the fluid velocity caused by a pump shutdown, or a sudden valve closure, or time variation in the demand. The high pressures that arise from surge events can have disastrous impacts on the pipeline infrastructure, such a pipeline bursting (for large positive pressure waves) or pipeline collapse (for large negative pressure waves). Traditionally, a water hammer analysis is undertaken within a deterministic framework using fixed parameter values for pipeline properties. Field tests show that the pipeline parameter values are, in fact, not fixed, but they vary spatially along the pipeline. This spatial variability induces a significant change in the water hammer wave as it propagates down a pipeline, causing a much different appearance in the wave form than would otherwise be observed.

Through the coupling of stochastic uncertainty simulators (e.g. Monte Carlo) and numerical differential equation solvers, this project aims to investigate techniques to characterise these changes in the water hammer wave due to the spatial variability of the pipeline properties. The impact of stochastic demand models on the peak surge pressures experienced in pipelines will also be investigated.

Project Code: W04 Offered to: Honours
Primary Supervisor: Aaron Zecchin Co-Supervisor: Brendan Scott
Project Title: **Performance characterisation of the Ecosol Cartridge Filter**

Industry Partner: Ecosol

Is the research likely to involve:

- Computer Simulation:.....Potentially
- Lab work:.....Yes
- Field work:.....Potentially
- Site visit(s):.....Yes

Does the project follow on from a previous year? .....No | N/A

Research Project Description:

This project will have support from an industry partner (Ecosol) who designs and manufactures stormwater treatment products. This research project will focus on the characterisation of the Ecosol Cartridge Filter, a product that is designed to filter stormwater run-off through a filter media that uses a physical process of filtering out particulates from the water. This device is commonly installed in industrial and commercial sites such as car parks, shopping centres, wash bays, and for retrofitting into high-density urban developments.

The project is proposed to consist of a literature review on like filtration devices, focussing on the filtration mechanisms and performance characterisation of these devices. The project will involve designing and undertaking an experimental program at Ecosol's in-house testing facility at Pooraka. Repeated experiments that will involve determining the treatable flow rate and capture efficiencies of the filter are proposed (to make this as rigorous a scientific process as possible). Subsequent analysis of experimental results (including statistical analysis to consider the significance of the conclusions) is proposed; it is also possible that some hydraulic modelling may be undertaken to determine how a predicted model compares with actual filter performance.

Project Code: W05 Offered to: Honours
Primary Supervisor: Holger Maier Co- Supervisor: Aaron Zecchin
Project Title: **Incorporation of Domain Knowledge into the Optimisation of Water Distribution Systems using Ant Colony Algorithms**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work: .....No
- Site visit(s):.....No

Does the project follow on from a previous year?..... No | N/A

Research Project Description:

Genetic algorithms have been used successfully for the optimisation of water distribution systems since the 1990s and are still the most commonly used algorithm for this purpose. As we are solving more and more complex problems, there is value in incorporating domain knowledge into the optimisation process so that solutions that are not sensible or impractical are eliminated from consideration, thereby speeding up the optimisation process and increasing the chances of finding better solutions. However, this is difficult to achieve when genetic algorithms are used. In contrast, by using ant colony optimisation algorithms, domain knowledge can be incorporated relatively easily. However, this has not yet been done. Consequently, the objectives of this project are (i) to investigate different ways in which domain knowledge / experience can be incorporated into the optimisation of water distribution systems using ant colony algorithms and (ii) to test the benefits of the incorporation of this knowledge in terms of increased computational efficiency and improved solutions quality for a range of water distribution systems.

Project Code: W06 Offered to: Honours
Primary Supervisor: Joshua Cantone Co-Supervisor: Angus Simpson
Project Title: **Simulation and Optimisation of Multiple Aquifer Stormwater Harvesting Schemes**

Industry Partner: Wallbridge & Gilbert

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work:.....No
- Site visit(s):.....Yes

Does the project follow on from a previous year? ..... Yes | 2013

Research Project Description:

Stormwater harvesting and reuse is becoming more common practice as potable water becomes more expensive and drought threatens traditional water sources. South Australia has pioneered the design and adoption of stormwater harvesting schemes incorporating aquifer storage and recovery over the past 10 years and infrastructure now exists to harvest in excess of 15 GL of stormwater in the state. A tool has recently been developed to simulate and optimise the design of such stormwater schemes to help practitioners better understand and design such schemes. The tool development is in its infancy and requires further adaptation to allow it to simulate and optimise alternative stormwater harvesting schemes. To date the development of schemes has been independent but there now exists an opportunity to link schemes with ASR at multiple locations within a region. This will result in additional flexibility in operation of these schemes. This project will further develop the simulation and optimisation tool and test it on a number of case studies based on existing and proposed stormwater harvesting schemes. The tool to be adapted links a water balance model in Microsoft Excel with EPANET and utilises a genetic algorithm for optimisation. The key features of this project will be to allow simulation of multiple aquifer sites and assessment of how these schemes can create operational flexibility and efficiency over the life cycle of the scheme.

Project Code: W07 Offered to: Honours & Masters
Primary Supervisor: Martin Lambert
Project Title: **Pipe Condition Assessment using Fluid Transients**

Industry Partner: Dr Mark Stephens - SA Water

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....Yes
- Field work: .....Yes
- Site visit(s):.....Yes

Does the project follow on from a previous year?.....Yes | 2013

Research Project Description:

Water distribution pipeline systems are required for every city and town. Due to their sheer size and extent, they have become one of the modern world's most costly and difficult areas of infrastructure to maintain. This is due to (i) the size of the infrastructure, (ii) the fact that much of the system is buried underground and not easily observable, and (iii) the system is subject continual structural degradation of the pipeline wall from internal and external processes (e.g. corrosion and fatigue). Rapid and accurate assessment of pipeline condition is essential to enable the development of strategically focused asset replacement programs. To achieve this, water utilities require condition assessment methods that diagnose not only how deteriorated a pipeline is, but also the location and extent of the critically deteriorated sections. This project will focus on the best ways to obtain a condition assessment of underground pipes using small fluid transients (small water hammer waves).

Project Code: W08 Offered to: Honours & Masters
Primary Supervisor: Martin Lambert Co-Supervisor: Joby Boxall (UK)
Project Title: **Reducing the Risk of Discolouration Events in Water Distribution Systems - Monitoring and Prevention**

Industry Partner: Dr Mark Stephens - SA Water

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....Yes
- Field work:.....Yes
- Site visit(s):.....Yes

Does the project follow on from a previous year? ..... Yes | 2013

Research Project Description:

Discoloured water is a major challenge for the water industry. This project will investigate methods to monitor and then flush particles which cause the discolouration from the water distribution system. The project will establish turbidity monitoring sensors that can be attached to fire hydrants or scour valves in the water distribution that will be able to monitor the clarity of the water flowing in the pipe. If the flow rate in the pipe is increased by opening a flushing valve or another hydrant then the faster velocity water will begin to pick up or shear off material within the pipe. The turbidity sensors will be able to monitor the material which is removed and tell the operators when the water clarity has returned. Pipes which have not been flushed for a long period can represent a significant risk to being the cause of discolouration if the flow rate or velocity within the pipe is suddenly increased. This project will develop the monitoring systems for this project in collaboration with the University of Sheffield and undertake tests on water distribution assets in South Australia. The project will involve field work but also modelling to understand the build-up and wash off of material within the pipes.

Project Code: W09 Offered to: Honours & Masters
Primary Supervisor: Martin Lambert
Project Title: **The Impact of Iron forming Bacteria Biofilm Development on Pipe Roughness and System Performance**

Industry Partner: SA Water - Peter Forward

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....Yes
- Field work: .....Yes
- Site visit(s):.....Yes

Does the project follow on from a previous year?.....Yes | 2013

Research Project Description:

This project will examine the increase in pipe roughness with time from biofilm build up in the pipe systems of the River Murray Salt Interception Scheme. The Salt Interception Schemes (SIS) of South Australia utilise borehole pumping as an essential component of the salinity mitigation strategies and have been burdened with severe iron biofouling within the pipelines and pumps, resulting in substantial economic losses. The aim of this study is to investigate the growth rate of iron biofilms, and their subsequent impact on pipe friction and system performance. This work will compare the impact of biofilms and biofouling on pipe roughness and system performance. The work will be conducted in the hydraulics laboratory on the pipe roughness experimental apparatus and also will involve field work. The change in roughness with time will be recorded and also the impact of flow velocity on the ultimate roughness. Mechanisms and models for the build of biofilms and how it impacts on the pipeline roughness will be sort. Experimental pipelines of 50 m and 100 m length and varying diameters (26, 32 and 51 mm) have been constructed at Bore 24 of the Woolpunda scheme and the iron biofilm growth recorded so far has been substantial for each pipeline. In addition, pressure data was also logged at five points along a 16 km large diameter transmission pipeline. This year I would like to focus techniques to better understand the Iron bacteria community and link that back to the engineering aspects.

Project Code: W10 Offered to: Honours & Masters
Primary Supervisor: Martin Lambert
Project Title: **Pipe Condition Assessment using Acoustic Methods**
Industry Partner: Stephen Simmons- Detection Services

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....Yes
- Field work:.....Yes
- Site visit(s):.....Yes

Does the project follow on from a previous year? ..... Yes | 2013

Research Project Description:

Water distribution pipeline systems are required for every city and town. Due to their sheer size and extent, they have become one of the modern world's most costly and difficult areas of infrastructure to maintain. This is due to (i) the size of the infrastructure, (ii) the fact that much of the system is buried underground and not easily observable, and (iii) the system is subject continual structural degradation of the pipeline wall from internal and external processes (e.g. corrosion and fatigue). Rapid and accurate assessment of pipeline condition is essential to enable the development of strategically focused asset replacement programs. Acoustic leak detection is common place in water distribution systems and has been very effective at finding leaks in water mains and attached services. This project will examine how acoustic waves travel in pipes and how they can be measured. Part of the project will involve understanding how existing techniques work and look for ways in which they can be improved. Techniques are available to determine the average wall thickness of a pipe by examining the acoustic wave speed and relating this to the wall thickness. This project will investigate the feasibility of developing a new technique which utilises the reflections from a propagating acoustic wave to determine changes in the pipe wall thickness of the pipe.

Project Code: W11 Offered to: Honours & Masters
Primary Supervisor: Angus Simpson
Project Title: **Development of a Benchtop Numerical Model Long Timeframe Simulator for Water Distribution Systems**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work: .....No
- Site visit(s):..... Potentially

Does the project follow on from a previous year?..... No | N/A

Research Project Description:

Water distribution systems analysis involves determination of flow rates and pressures in a network. An economic evaluation of various possible alternatives can be achieved by simulating and optimizing the water distribution system to determine what elements need to be added to the system so that the performance is optimal. Over the past 15 to 20 years, the sophistication of water distribution simulation modelling has grown immensely. Real-time water distribution control, operation and optimization is a new area of research.

The aim of this research project is to develop using a standard water distribution simulation computer program (such as EPANET) a long timeframe extended period simulator of a water network. This model will be known as a Benchtop Numerical Water Network Model. Seasonal, weekly and daily random water demands will be generated that will need to be supplied by the water network system. Pumps will need to be operated and their operations optimised to reduce both cost of operations and minimising greenhouse gas production. SCADA (Supervisory Control and Data Acquisition) data at say 15 minute intervals will be generated by the model for which the network characteristics will be pre-specified exactly (these include network topology, pipe lengths and diameters, pipe roughnesses, nodal elevations, pump, tank and valve characteristics). Data will then be generated including flows at a limited number of points in the network (at the location of flow meters), pressures at a few points in the network, tank level variation, pump flows and heads. This data will then provide a source of data that can be analysed to calibrate the pipe roughnesses and water demands (as if the characteristics of the Benchtop Numerical Water Network Model are actually unknown) and will also enable operational optimisation strategies for pumping to be tested. Once the simulator is developed various tests can be carried out for, for exa

Genetic Algorithm (GA) Optimisation will be used for optimising pump operations. In the early 1990s, Professor Simpson pioneered the development of the use of genetic algorithm (GA) techniques for the optimisation of the design of water distribution systems (WDS). GA optimisation is a population based technique that has analogies to natural genetics where survival of the fittest plays an important role. The major genetic algorithm operators are selection, crossover and mutation. The “fitness” of each proposed pumping operational strategy is determined based on costs and greenhouse gas emissions and by assessing whether any of the design constraints are violated by the design. A penalty cost is assigned to networks that do not meet the design criteria. GA optimisation is able to determine the optimal pump operational strategies.

Project Code: W12 Offered to: Honours
Primary Supervisor: Seth Westra Co-Supervisor: Holger Maier
Project Title: **Securing water supply under a changing climate – a case study in Vietnam**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work: .....No
- Site visit(s):.....No

Does the project follow on from a previous year?.....Yes | 2013

Research Project Description:

Climate is a fundamental driver of the hydrological cycle, and influences both water supply and water demand. Anthropogenic climate change is expected to pose a significant risk to global water security and will make managing and planning water supplies an increasingly challenging task. Successful management of water resources under a changing climate requires the ability to accurately assess the performance of water infrastructure, such as reservoirs. However, current approaches often fail to utilise climate science information relevant to water infrastructure performance. In previous research, statistical methods of changing the rainfall pattern related to different climate drivers have been developed and the preliminary relationship between these patterns, the causative climate drivers and hypothetical reservoirs with different characterisers has been investigated. In this project, the relationships developed in the previous research project will be further investigated and tested on a real reservoir system in the Dong Nai River Basin, Southern Vietnam. The current operational rules of the reservoir system will be analysed to seek improvement of the management of these reservoirs under a changing climate.

The overall aim of the project is to 1) investigate the relationship between rainfall patterns and reservoirs with different characteristics; 2) apply the above results to the analysis of the reservoir system in the Dong Nai River Basin, Southern Vietnam; 3) investigate the current operational rules of the reservoir system; and 4) improve the current operational rules of the reservoir system considering climate change.

Project Code: W13 Offered to: Honours
Primary Supervisor: Seth Westra Co-Supervisor: Michael Leonard
Project Title: **An Economic Cost-Benefit Analysis of Flood Hazards under Historical and Future Climates**

Is the research likely to involve:

- Computer Simulation:.....No
- Lab work:.....No
- Field work:.....No
- Site visit(s):.....No

Does the project follow on from a previous year? .....No | N/A

Research Project Description:

The annual average cost of floods in Australia has been estimated at $377m, but individual events such as the 2008 Newcastle flood and 2011 Queensland floods have damage bills totalling billions of dollars. Similarly, preventing and mitigating floods is not cheap. Consider, for example, the total cost of Australia's stormwater channels, bridges, levees, sea walls, spillways, reservoirs, detention basins and other water infrastructure assets. Since the total value and performance of these assets is not known, the cost-benefit of flood hazards and Australia's exposure to future flood hazards is unclear. The aim of this project is to establish the business case for flood defence in Australia and in doing so, to evaluate whether the canonical 1 in 100 year flood risk is an appropriate level of protection. The challenge of this task is augmented by the possibility and uncertainty whether flood risk will change in the future and resulting questions over the appropriate parameters for design (e.g. should the risk be integrated over the design life, taken at the end of the design life, median risk, average projection)?

Project Code: W14 Offered to: Honours & Masters
Primary Supervisor: Angus Simpson
Project Title: **Non-Invasive Pipe Condition Assessment Using Water Hammer Transients**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work: .....No
- Site visit(s):.....Potentially

Does the project follow on from a previous year?..... No | N/A

Research Project Description:

Over the last 18 years at the University of Adelaide, a large research group led and Professor Angus Simpson and Professor Martin Lambert has been formed that has developed a number of new techniques using transients (or water hammer) for condition assessment of water distribution systems. The techniques allow determination of condition assessment of the interior of pipes (cement mortar lining spalling, corrosion), the detection of closed valves, leaking valves and blockages, leakage detection and pipe roughness calibration in pipe networks. The new techniques include the inverse transient technique, the transient damping method, frequency domain techniques and wave timing and shifting techniques. The use of transients for condition assessment of pipes, the determination and location of anomalies in a pipeline is a relatively new field.

For the determining pipe condition using transients, the variation in hydraulic grade line is measured at a number of locations along a pipe. A special controlled small magnitude water hammer event is created by a transient generator (usually a side discharge valve). This research project will generate using a method of characteristics computer program pressure traces for various combinations of anomalies in pipeline systems. These various computer runs will produce pressure trace data from pipelines with exactly known characteristics and anomalies. This data will become a repository of Test Data.

Various existing software packages that have been previously developed at the University of Adelaide will be used and further developed by this research group to detect and characterise the anomalies that are in the Test Data. Field data from trials around Australia is also available from various locations. This data will also be used in this research project. Moving these techniques into practical field application is challenging and is one of the current pursuits of the research team.

Project Code: W15 Offered to: Honours & Masters
Primary Supervisor: Angus Simpson
Project Title: **Evolutionary Algorithm Optimisation of Design and Operation of Water Networks for Multiple Objectives Including Economic Cost and GHG Emissions**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work:.....No
- Site visit(s):.....Potentially

Does the project follow on from a previous year? ..... Yes | 2013

Research Project Description:

Water Distribution Systems can be expensive infrastructure to design, construct, operate and maintain. Increasingly, the optimisation of these systems is needed, with the common objectives being to reduce costs and, more recently, to lower the environmental impact of the systems, and also to improve the reliability of these systems. Genetic Algorithms have been shown to handle discrete and often complex combinatorial solution spaces very well and when compared to other optimisation techniques they are able to find optimal or near optimal solutions in relatively few evaluations compared to the size of the solution space.

This project will continue to develop an interface between Excel, EPANET and various evolutionary algorithm types (genetic algorithms, Differential Evolution, Ant Colony Optimisation). A previous award winning research group has already made significant progress in commencing this development. This development will be referred to as AdelEAOpt. Two similar interfaces have been developed – one at the University of Exeter, England and the other at the University of Bari in Italy.

Various network design optimisation problems and pumping operations optimisation problems (including the use of trigger levels, the use of scheduling and the combination of both for various power tariff structures) will be considered in this project. A comparison of the three different software packages will be carried out. One challenge will be to try to develop the best evolutionary algorithm implementation within AdelEAOpt. So a significant part of this research project will be investigating all the current evolutionary algorithms types and determining which of them works the best. Multiple criteria optimisation will also be built into the software, in particular, accounting for the minimization of economic costs and greenhouse gases. Tradeoff curves showing the Pareto tradeoff curve will be developed.

Project Code: S01 Offered to: Honours & Masters
Primary Supervisor: Chengqing Wu
Project Title: **Dynamic analysis of steel tubar confined concrete columns against blasts**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....Yes
- Field work: .....Potentially
- Site visit(s):.....Potentially

Does the project follow on from a previous year?..... No | N/A

Research Project Description:

Due to the rising threat of terrorism, designing public structures in Australia and abroad against explosive blasts has become a major concern over the past decade. Hence, it is very important to ensure the structural integrity against blast loads of key structural members in high priority infrastructure which includes embassies and government buildings. Although experimental and analytical studies have been conducted on resistance of RC members, little research has been conducted to investigate the performance of steel tubar confined concrete columns under blast loads experimentally and analytically. Since the mechanical properties of steel tubar confined concrete are significantly different from those of unconfined concrete, the conventional analytical methods such as single degree of freedom and finite element models for analysis and design of conventional RC columns against blast loads, needs to be significantly adapted and extended to accommodate steel tubar confined concrete columns. This study will use single degree of freedom, commercial software and finite element methods to model the response of steel tubar confined columns under blast loads. A series of blast tests will be conducted to validate the numerical models. Pressure and impulse diagrams will be derived from the study.

Project Code: S02 Offered to: Honours & Masters
Primary Supervisor: Chengqing Wu
Project Title: **Shear response analysis of steel fibre concrete members against blast loads**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....Yes
- Field work:.....Potentially
- Site visit(s):.....Potentially

Does the project follow on from a previous year? ..... Yes | 2012

Research Project Description:

Due to the increase of terrorist attacks and various accident explosions in recent years, structural response against blast loading have become more and more important issues for the government and engineering societies. Steel fibre concrete is of very high strength, high deformation and high toughness in comparison with conventional concrete, making it an ideal material for construction of key members of these buildings. When steel fibre concrete members are subjected to high amplitude blast loads, structural failure is governed by crushing and spalling of concrete, by direct shear damage, whereas under low amplitude overpressure, the structural failure is most likely governed by flexural damage. However, due to the difficulties to obtain shear force slip relationship of structural members, the direct shear response analysis of structural members under high amplitude shock loading are usually not taken into consideration in the previous studies. The objective of this project is to investigate the shear responses of steel fibre concrete members against blasts. Experimental and numerical studies (LSDYNA) will be conducted to investigate shear force slip relationships of steel fibre concrete members. The shear force slip relationships are then incorporated to the SDOF and FEM system for dynamic analysis. A series of blast tests will be conducted to validate the SDOF and FEM models. Pressure impulse diagrams will be derived using the SDOF and FEM models.

Project Code: S03 Offered to: Honours & Masters
Primary Supervisor: Chengqing Wu
Project Title: **Protection of RC Structures against blast loading**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....Yes
- Field work: .....Potentially
- Site visit(s):.....Potentially

Does the project follow on from a previous year?.....Yes | 2012

Research Project Description:

Project: Development of advanced composite structural members with a high resistance against blast loading is an emerging research area as well as a national research priority under anti-terrorism and safeguarding Australia. Preliminary studies have demonstrated that aluminium foam protected structural members have a great potential to resist blast and impact loads effectively. Aluminium foam is a type of closed cell metallic foam manufactured through melt gas injection. It has a very good compression property that can be closely characterized by a stress-strain curve having elastic, long prefect-plastic plateau and densification stages. This property enables the material to undergo a very large deformation and it helps to absorb a good amount of energy in mitigating the effect of blast loads on structures. However, much work needs to be conducted to understand the blast mitigation mechanisms and use that in the design of engineering structures in order to ensure the safety and survivability of these structures used in civil and defence infrastructure. The aim of the proposed study is to identify the dominant blast mitigation features which will allow design engineers to take the advantage of desirable properties of this special material i.e., aluminium foam as well as pumice blanket and polyurethane coating for protection of existing structures against blast loads. An experimental blast program will be conducted. In addition to the use of LSDYNA for modelling the blast load, a finite element models will be developed to perform the dynamic analysis.

Project Code: S04 Offered to: Honours & Masters
Primary Supervisor: Chengqing Wu
Project Title: **Dynamic analysis of ultra high performance concrete columns against blasts**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....Yes
- Field work:.....Potentially
- Site visit(s):.....Potentially

Does the project follow on from a previous year? .....No | N/A

Research Project Description:

Due to the rising threat of terrorism, designing public structures in Australia and abroad against explosive blasts has become a major concern over the past decade. Hence, it is very important to ensure the structural integrity against blast loads of key structural members in high priority infrastructure which includes embassies and government buildings. Although experimental and analytical studies have been conducted on resistance of RC members, little research has been conducted to investigate the performance of ultra high performance concrete columns under blast loads experimentally and analytically. Since the mechanical properties of ultra high performance concrete are significantly different from those of conventional concrete, the conventional analytical methods such as single degree of freedom and finite element models for analysis and design of conventional RC columns against blast loads, needs to be significantly adapted and extended to accommodate ultra high performance concrete columns. This study will use single degree of freedom, finite element methods and commercial software to model the response of ultra high performance concrete columns under blast loads. A series of blast tests will be conducted to validate the SDOF, LSDYNA and FEM models. Pressure impulse diagrams will be derived using the SDOF and FEM models.

Project Code: S05 Offered to: Honours & Masters
Primary Supervisor: Giang Nguyen
Project Title: **Finite element formulation for concrete cracking**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work: .....No
- Site visit(s):.....No

Does the project follow on from a previous year?..... No | N/A

Research Project Description:

The project will develop a new 2D finite element formulation for concrete taking into account its cracking behaviour. A 2D finite element will be enhanced with an additional kinematic mode of deformation when cracking takes place. This will help relax the stress due to material cracking. Numerical analysis will be carried out to study the behaviour of the new element under different loading conditions. The element will be implemented in a Finite Element code for the study of failure of concrete structures.

Project Code: S06 Offered to: Honours & Masters
Primary Supervisor: Giang Nguyen
Project Title: **Formulation and modelling of reinforced concrete beam finite elements**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work:.....No
- Site visit(s):.....No

Does the project follow on from a previous year? .....No | N/A

Research Project Description:

The project will develop a new beam finite element for the nonlinear analysis of reinforced concrete structures. The effects of concrete fracture in tension, crushing in compression and steel yielding will be explicitly taken into account. The new beam element will be implemented in a simple finite element code and combined analysis-design carried out. This is totally different from traditional approaches when the analysis and design are usually separated and contain inconsistent assumptions. The results will be compared with those from the traditional approach.

Project Code: S07 Offered to: Honours & Masters
Primary Supervisor: Giang Nguyen
Project Title: **Numerical study of fracture properties of concrete**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work: .....No
- Site visit(s):.....No

Does the project follow on from a previous year?..... No | N/A

Research Project Description:

The project aims at numerically investigating the fracture properties of concrete using the Finite Element Method and advanced material models. All constituents of concrete (aggregate, mortar and their interfacial zone) will be explicitly modelled. The effects of aggregate size and shape, strength and stiffness of both aggregate and mortar on the behaviour and fracture of concrete will be investigated. The students should have good computer skills and background in Finite Element Method.

Project Code: S08 Offered to: Honours
Primary Supervisor: Hamid Sheikh Co-Supervisor: Giang Nguyen
Project Title: **Finite element analysis of steel concrete composite beams**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work:.....No
- Site visit(s):.....No

Does the project follow on from a previous year? ..... Yes | 2013

Research Project Description:

The use of steel concrete composite beams is quite common in various civil engineering constructions. The shear connectors are used to connect the concrete slab with the steel girder to have a monolithic behaviour of the structural system through composite actions. It has been observed that the deformation of shear connectors has a significant effect on the structural response. This has drawn attentions of many researchers and as a result of that, a number of models have been developed. Interestingly, most of the modes did not consider the effect of the shear deformation of the beam layers. Keeping this aspect in view, attempts have been made by final year structural engineering students of previous years to develop an elegant Finite Element Model where the shear deformation has not only been considered in an efficient manner but also provision has been kept to allow different distribution of the shear strain for the steel girder and the concrete slab. If a structure is subjected to higher range of loads, the effect of nonlinearity due to material yielding and large deformation is found to be quite significant. As the abovementioned finite element model developed at the University of Adelaide has the capability of analysing composite beams successfully in the linear range, the objective of the proposed research is to develop an improved Nonlinear Finite Element Model which can be used to study the behaviour of these structures in a realistic manner. The research will provide an opportunity of in depth understanding of composite structures and the Finite Element technique through development of computer programs.

Project Code: S09 Offered to: Honours & Masters
Primary Supervisor: Hamid Sheikh
Project Title: **Interaction of different buckling modes in steel structural members**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work: .....No
- Site visit(s):.....No

Does the project follow on from a previous year?.....Yes | 2013

Research Project Description:

Steel structures are widely used in various civil engineering activities. A typical member of these structures is often subjected to different modes of buckling such as local plate buckling, flexural–torsional global buckling and distortional buckling under the action of different load combinations. The phenomenon of the distortional buckling mode found in cold form steel structures is quite complex and this buckling mode is often found to have interaction with other buckling modes which makes the problem more challenging. Unfortunately the actual scenario due to the interaction of these buckling modes cannot be captured properly with the rules recommended by any steel design code. Thus there is a requirement for the development of a proper technique which will be able to assess the actual behaviour of these structures. The finite element method will be used to solve the problem utilising a most powerful finite element software Abaqus. The results obtained in this research will be used to develop some design formula which should be useful to practicing engineers. The research will provide an opportunity of the in depth understanding of steel structures and a very good understanding and skill of applied Finite Element modelling.

Project Code: S10 Offered to: Honours & Masters
Primary Supervisor: Hamid Sheikh Co-Supervisor: Michael Griffith
Project Title: **Modelling of ultra high performance concrete structural members**

Industry Partner: Defence Science and Technology Organisation (DSTO)

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work:.....No
- Site visit(s):.....No

Does the project follow on from a previous year? ..... Yes | 2013

Research Project Description:

Ultra high performance concrete (UHPC) is a relatively new upcoming material which has a huge potential of its application in various civil engineering structures. The material may have a really high compressive strength which is about 10 times of the normal concrete strength. For a very dense formation of the material, its ductility is usually less but this is enhanced by adding small steel fibres in the concrete mix which helps to achieve a significantly high tensile failure strain due to fibre bridging. This specific aspect is extremely important in a structure subjected to severe dynamic loads such as blast loading. This is a research project will be running in collaboration with Defence Science and Technology Organisation (DSTO), Australia, as they are interested to study the behavior of UHPC structural member under blast loads that will support one of their activities related to design of blast resistance structures. A group of final year students of this year worked on this project and made a good start and you are expected to extend it further. The research will provide an opportunity of in depth understanding of UHPC and Finite Element modelling of structures. You will also be using a most powerful finite element package (Abaqus) which will help to develop skills in applied Finite Element modelling.

Project Code: S11 Offered to: Honours & Masters
Primary Supervisor: Mohammed Ali
Project Title: **Structural behaviour of long span bridges**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....Potentially
- Field work: .....No
- Site visit(s):.....No

Does the project follow on from a previous year?.....Yes | 2013

Research Project Description:

The use of multi-cell box girders in bridge deck construction can lead to considerable economy; these bridges combine excellent torsional stiffness with elegance. This type of construction leads to an efficient transverse load distribution, due to the excellent torsional stiffness of the section. Further, utilities and services can be readily provided within the cells. An extensive theoretical investigation using commercially available finite element packages such as ABAQUS/ANSYS will be conducted to determine the effect of several variables on the moment and shear distributions in simply supported straight composite concrete deck-steel multi-cell box girder bridges. Expressions will be deduced for computing the moment distribution factors for each girder and the shear distribution factor at each web. The results from this investigation provide valuable design information currently unavailable in bridge codes for the design of composite cellular bridges subject to Australian bridge design loads.

Project Code: S12 Offered to: Honours
Primary Supervisor: Mohammed Ali Co-Supervisor: Phillip Visintin
Project Title: **Structural behaviour of Ultra-High Performance Concrete (UHPC)**

Is the research likely to involve:

- Computer Simulation:.....No
- Lab work:.....Yes
- Field work:.....No
- Site visit(s):.....Potentially

Does the project follow on from a previous year? ..... Yes | 2013

Research Project Description:

Ultra-High Performance Concrete (UHPC) is a new form of concrete which is reinforced with random short fibres. These fibres give the concrete high compressive strengths in the range of 150+MPa, the capacity to carry load post cracking and consequently high ductility. These favourable material properties mean UHPC can be used to construct structural members where high performance is required.

In this project students will test and simulate the response of structural elements manufactured from UHPC developed at Adelaide Uni.

Note some computer programming will be required in order to carry out the analysis.

Project Code: S13 Offered to: Honours
Primary Supervisor: Phillip Visintin
Project Title: **The influence of reinforcement corrosion on the long term deflection of RC beams**

Is the research likely to involve:

- Computer Simulation:.....No
- Lab work:.....No
- Field work: .....No
- Site visit(s):.....No

Does the project follow on from a previous year?..... No | N/A

Research Project Description:
When a concrete member is subjected to a load its response is both instantaneous and time dependent.

The influence of time dependent deformation is particularly important because it may lead to serviceability failures in structural members where deflections or crack widths are excessive. Current analysis techniques for reinforced concrete members are built around a moment–curvature approach and therefore based on the assumption of full-interaction, that is, the reinforcement does not slip relative to the concrete which encases it. Consequently, the widening of cracks and their effect on deflection cannot be simulated directly and in order to determine member deflection, empirically derived expressions for the flexural rigidity of a member are required to allow for the tension stiffening associated with cracking.

In contrast to this full interaction approach, a partial-interaction moment–rotation approach has been developed which directly allows for slip between the reinforcement and concrete including the influence of time effects, that is, concrete shrinkage and creep. Being based on the mechanics of partial-interaction theory, application of the moment-rotation approach obviates the need for the empirically derived flexural rigidities and automatically allows for tension stiffening.

In this project the partial-interaction behaviour of a section under sustained load will be simulated and the additional influence of concrete durability and reinforcement corrosion on tension stiffening simulated. The mechanics of the approach will be solved numerically and, following this, simplifications made to develop simple closed for solutions for application in design.

Please note that this project will require computer programming.

Project Code: S14 Offered to: Honours
Primary Supervisor: Phillip Visintin
Project Title: **A design based approach for predicting long term deflections in reinforced concrete**

Is the research likely to involve:

- Computer Simulation:.....No
- Lab work:.....No
- Field work:.....No
- Site visit(s):.....No

Does the project follow on from a previous year? .....No | N/A

Research Project Description:
Being able to predict the long term deflections of reinforced concrete allowing for the influence of concrete shrinkage and creep is an essential part of designing for serviceability.

Current design approaches are based on the moment curvature analysis and the corollary of full interaction, that is, it is assumed that there is no slip between the reinforcement and the concrete and therefore empirically tension stiffening must be approximated empirically.

In this project a numerical based approach, which is directly based on the mechanics of partial interaction, that is on the mechanism of reinforcement slip relative to the concrete will be simplified to allow for the development of closed form solutions for application in design.

Project Code: S15 Offered to: Honours
Primary Supervisor: Phillip Visintin Co-Supervisor: Mohammed Ali
Project Title: **The development of geopolymer structural concrete**

Industry Partner: Department of Planning Transport & Infrastructure / Hallett Concrete

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....Yes
- Field work: .....Yes
- Site visit(s):.....Yes

Does the project follow on from a previous year?.....Yes | 2013

Research Project Description:

The manufacture of concrete using Ordinary Portland Cement is highly polluting with every kg of cement manufactured releasing approximately 1kg of Carbon Dioxide emissions. In response to the South Australian Department of Planning Transport and Infrastructure and the concrete manufacturer Hallett Concrete is seeking to develop a 'green' geopolymer concrete.

Geopolymer concretes contain no Ordinary Portland Cement but rather are manufactured using cementitious materials such as fly ash from power stations and blast furnace slags from smelting operations.

This project will continue industry funded research conducted by Dr. Phillip Visintin and Dr. Mohammed Ali and seek to quantify the material properties essential for structural analyses.

Project Code: S16 Offered to: Honours & Masters
Primary Supervisor: Terry Bennett
Project Title: **Investigation into the effect of the microstructure on the performance of concrete**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work:.....No
- Site visit(s):.....No

Does the project follow on from a previous year? .....No | N/A

Research Project Description:

The mix design for a given concrete can have a significant influence on the mechanical properties of concrete. This project will investigate the effect that the percentage and size of aggregates can have on the stiffness and tensile strength of concrete.

The project will involve the writing of a particle packing algorithm to make virtual laboratory samples for testing in a finite element code. Students will learn how to create and run models for advanced finite element simulations. The simulations will be used as a virtual laboratory to investigate how the individual components within concrete influence the macroscopic behaviour of the material.

Project Code: S17 Offered to: Honours & Masters
Primary Supervisor: Terry Bennett
Project Title: **The response of structures and components to blast loading**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work: .....No
- Site visit(s):.....No

Does the project follow on from a previous year?..... No | N/A

Research Project Description:

Blast loading on structures can arise from industrial accidents and terrorist incidents, leading to the requirement that at risk or safety critical infrastructure needs to be designed to resist blast loading.

This project will require the determination of blast loads dependent upon the size of charge, stand-off distance and type of explosive encountered. Once the loading is ascertained for a given scenario, it will be applied to simple engineering components.

The performance (deflections, integrity, etc) of these components will be evaluated using simplified one-degree-of-freedom methods as well as using dynamic finite element modelling.

Project Code: S18 Offered to: Honours & Masters
Primary Supervisor: Terry Bennett
Project Title: **The response of structural components to resist fragments and impact**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work:.....No
- Site visit(s):.....No

Does the project follow on from a previous year? .....No | N/A

Research Project Description:

Structures can, accidentally or intentionally, be subjected to extreme dynamic loading in the form of flying fragments or impact events. To negate the effects of such events, structural components may be clad with sacrificial materials for protection.

This project will involve the use of advance simulation techniques to model the protective capability of honeycomb and foam materials against high velocity impacts. Material models available in state of the art finite element packages will model the material behaviour of both the sacrificial cladding materials and the impactor. Parameters such as the velocity of impact, shape of impactor and depth of cladding will be explored to inform the design of panels.

Project Code: S19 Offered to: Honours & Masters
Primary Supervisor: Terry Bennett
Project Title: **Investigation into the strain rate dependent behaviour of concrete**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work: .....No
- Site visit(s):.....No

Does the project follow on from a previous year?..... No | N/A

Research Project Description:

Whilst most structural design and analysis is performed on the static response of structures to slow moving or stationary loading, many structures may be exposed to dynamic loading. The properties (Young's modulus, tensile strength, etc) of materials may vary considerably depending upon the rate of loading applied. In order that structures and components can be designed for high strain rate dynamic events, such as blast and impact, the material properties at high strain rates need to known.

This project will explore how material properties are affected by the rate of loading and how they may be measured experimentally. Using dynamic finite element analysis, Hopkinson bar experiments will be recreated virtually, and the material models for concrete available in commercial software evaluated for their efficacy in predicting the real experiments.

Project Code: S20 Offered to: Honours & Masters
Primary Supervisor: Togay Ozbakkaloglu
Project Title: **Design and manufacture of ultra high-performance composite concrete columns**

Is the research likely to involve:

- Computer Simulation:..... Potentially
- Lab work:.....Yes
- Field work:.....No
- Site visit(s):.....No

Does the project follow on from a previous year? ..... Yes | 2013

Research Project Description:

The use of high-strength concrete (HSC) in building and bridge construction has increased over the last two decades, as HSC offers significantly better structural engineering properties compared with conventional normal-strength concrete, and forms an attractive alternative to other construction materials. In recent years, the use of fibre reinforced polymer (FRP) composites as concrete reinforcement has emerged as a popular technique. Their extremely high strength-to-weight ratio, corrosion resistance, and ease of application make FRP composites an attractive alternative for concrete reinforcement. One promising structural application of FRP composites involves the use of FRP to form a new type of structural system in the form of FRP-concrete composite columns.

Earlier tests on this structural system have demonstrated the effectiveness of FRP tubes in increasing the deformability of concrete columns, signifying the remarkable potential of the technique. These findings suggest that high-performance next-generation columns can be manufactured by combining these FRP tube systems with ultra high-strength concretes (UHSC) with strengths up to 200 MPa. Such columns can exhibit steel like strength and deformation capacities together with much better economy and durability in construction. The aim of this project is to experimentally investigate the structural behaviour of this high-performance structural system, which will lead to the design of next-generation columns.

Project Code: S21 Offered to: Honours & Masters
Primary Supervisor: Togay Ozbakkaloglu
Project Title: **Strength and ductility of concrete confined by advanced composite systems**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....Potentially
- Field work: .....No
- Site visit(s):.....No

Does the project follow on from a previous year?.....Yes | 2013

Research Project Description:

Concrete is the most commonly used construction material in the world. Concrete is energy efficient, versatile, cost-effective and fire resistant. However, concrete is also very brittle, and hence its use may pose a concern where ductile structural behaviour is required. In the past, researchers have extensively investigated the ways of improving the ductility of concrete. Among all the approaches studied, confinement of concrete, which involves restraining the lateral expansion of concrete through a tri-axial stress condition, was found to be by far the most effective.

There are a number of different techniques available for confining concrete. Over the last couple of years, the use of fibre reinforced polymer (FRP) tubes as confinement of concrete columns has been gaining increasing popularity because of the superior properties of the FRP material and the effectiveness of this confinement system. However, for safe and reliable design of such columns requires the development of models which can accurately predict the stress-strain behaviour of FRP-confined concrete. This project is aimed at developing a design-oriented model for the axial compression behaviour of FRP-confined concrete. An extensive test database that has already been compiled at the University of Adelaide and it will be available for the development of this model. Additional experimental tests will also be conducted as required.

Project Code: S22 Offered to: Honours & Masters
Primary Supervisor: Togay Ozbakkaloglu
Project Title: **Design of concrete-filled composite tubes as earthquake-resistant columns for new construction**

Is the research likely to involve:

- Computer Simulation:.....Potentially
- Lab work:.....Yes
- Field work:.....No
- Site visit(s):.....No

Does the project follow on from a previous year? ..... Yes | 2013

Research Project Description:

Earthquakes are potentially devastating natural events which threaten lives, destroy property, and disrupt life-sustaining services. The aim of this project is to investigate the use of a novel structural system for earthquake-resistant construction of concrete structures. Earlier tests on this structural system have shown that combining concrete and fibre reinforced polymer (FRP) composites in the form of concrete-filled FRP tubes offers a number of advantages. In this structural system, the FRP tube acts as a stay-in-place structural formwork to contain the fresh concrete, which may significantly reduce the costs of formwork and labour in construction. At the same time, the FRP tube acts as concrete confinement and eliminates the need for transverse steel reinforcement. Also benefiting from extremely high strength-to-weight ratio and corrosion resistance of FRP composites, this innovative structural system offers a very attractive alternative for earthquake-resistant construction. The outcomes of this research will lead to an improved understanding of this structural system, which will contribute towards the development of design guidelines for its use in practice.

Project Code: S23 Offered to: Honours & Masters
Primary Supervisor: Togay Ozbakkaloglu
Project Title: **Behaviour and design of FRP anchors**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....Potentially
- Field work: .....No
- Site visit(s):.....No

Does the project follow on from a previous year?.....Yes | 2013

Research Project Description:

Strengthening of concrete structures using fibre reinforced polymer (FRP) systems has become a widely accepted technology in the construction industry over the past decade. Externally bonded FRP sheets are proven to be a feasible alternative to traditional methods for strengthening and stiffening deficient reinforced or prestressed concrete members. However, the delamination of FRP sheets from the concrete surface poses major concerns, as it usually leads to a brittle and early member failure. The aim of this project is to develop an FRP anchor system to overcome delamination problems encountered in surface bonded FRP sheets. The behaviour of the FRP anchors will be investigated experimentally through direct pull-out tests that will be conducted on anchors embedded in normal- and high-strength concrete blocks.

Project Code: S24 Offered to: Honours & Masters
Primary Supervisor: Togay Ozbakkaloglu
Project Title: **Geopolymer concretes: Concrete goes green**

Is the research likely to involve:

- Computer Simulation:.....No
- Lab work:.....Yes
- Field work:.....No
- Site visit(s):.....No

Does the project follow on from a previous year? ..... Yes | 2010

Research Project Description:

Concrete is the most widely used construction material and demand for it is still on the increase. It is usually associated with Portland cement, which is typically used as a binder in manufacturing concrete. However, the climate change due to global warming, one of the greatest environmental issues, has recently become a major concern. The global warming is caused by the emission of greenhouse gases to the atmosphere by human activities. Among the greenhouse gases, it is predicted that CO2 contributes to about 65% of the global warming. The production of one ton of Portland cement emits approximately one ton of CO2 into the atmosphere, and consequently the cement industry is responsible for about 6% of all CO2 emissions. Many efforts are currently being made in order to reduce the use of Portland cement in concrete. These efforts include the utilisation of supplementary cementing materials such as fly ash, silica fume and granulated blast furnace slag, as well as finding alternative binders to Portland cement. In this respect, the geopolymer technology proposed by Davidovits in 1988 shows considerable promise for application in concrete industry as an alternative binder to the Portland cement. In terms of reducing the global warming, it is predicted that the geopolymer technology could reduce the CO2 emission to the atmosphere caused by cement and aggregates industries by about 80%. The aim of this project is to study the development of mixture proportions for various geopolymer concretes and to investigate the influence of main parameters on the engineering properties of these concretes.

Project Code: S25 Offered to: Honours
Primary Supervisor: Veronica Soebarto Co-Supervisor: tbc
Project Title: **Solar Decathlon 2014**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....Potentially
- Field work: .....No
- Site visit(s):.....Potentially

Does the project follow on from a previous year?..... No | N/A

Research Project Description:

This project will explore innovative and creative ideas as well as investigate strategies to develop a design and construction of a self-sustainable small scale building (45-70 m^2) by utilising the current brief for Solar Decathlon 2014 (http://www.solardecathlon2014.fr/sites/default/files/Reglement%20SDE%202014_0.pdf).

Elements of the design process include (but are not limited to); full structural analysis and sizing of structural members, selection and detailing of the materials, prove that the design meet thermal comfort and energy efficiency criteria, self-sufficient in water and waste management systems.

The output should include: a thesis/report covering:

(1) design (concept/approaches),
(2) strategies,
(3) calculations and/or simulation for structures, energy, comfort, costs, water/waste management, and
(4) drawings – working drawings

Practically, a construction company should be able to pick up the documents and actually build it.

This project is offered to Architectural Engineering students ONLY

Project Code: S26 Offered to: Honours
Primary Supervisor: Michael Griffith Co-Supervisor: H Derakhshan
Project Title: **Seismic retrofit/strengthening of unreinforced masonry walls for out-of-plane bending**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....Potentially
- Field work:.....No
- Site visit(s):.....No

Does the project follow on from a previous year? ..... Yes | N/A

Research Project Description:

Students will conduct a thorough review of the literature to first establish what the current state-of-the-art is for retrofit of unreinforced masonry (URM) walls with respect to out-of-plane bending. The will then attempt to assess the cost (material and application) to apply each of the techniques in order to rank them on the basis of a benefit/cost ratio. In order to quantify the benefit value for each technique, students will need to assess the seismic response of typical URM wall configurations in their 'unstrengthened' and 'retrofit' conditions and then use published damage ratio statistics from laboratory tests and previous earthquakes to assign dollar values to the various damage states for walls in each retrofit condition.

Project Code: S27 Offered to: Honours
Primary Supervisor: Michael Griffith Co-Supervisor: H Derakhshan
Project Title: **Improved assessment of out-of-plane seismic response of masonry walls**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work: .....No
- Site visit(s):..... Potentially

Does the project follow on from a previous year?..... Yes | N/A

Research Project Description:

Students will investigate the out-of-plane response of unreinforced masonry (URM) walls in the top storey of URM buildings typical of Adelaide. They will take into account that the motions in the buildings at the roof and top floor levels are not identical - this has never been done before. The results can be compared to the standard code (force-based) design procedures given in the Australian earthquake and masonry structures codes as well as a relatively new, but simplified, displacement-based design procedure first proposed by the supervisors in 2005. The students will need to perform some dynamic analysis of simple two and three degree of freedom systems and use the Australian Standards (AS 1170.4 and AS 3700).

Project Code: S28 Offered to: Honours
Primary Supervisor: Dr Alex Ching-Tai Ng
Project Title: **Improving understanding of high frequency vibration techniques for safety inspection of structures**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....Yes
- Field work:.....No
- Site visit(s):.....No

Does the project follow on from a previous year? ..... Yes | 2013

Research Project Description:

Engineering infrastructure plays an important role in our daily life. It enhances access to public services and both physical and service sector resources (e.g., bridges, buildings, aerospace, pipeline, wind energy generation as well as land and water transport infrastructure). The aging and deterioration of engineered infrastructure across the developed world have therefore become a universal challenge for governments and industries. Accumulation of damage over the lifespan of a structure without adequate and timely inspection can lead to catastrophic failure. Thus, monitoring structural integrity to enhance the sustainability and reliability of both new and old structures, and the reduction of their life cycle costs have become increasingly important.

This project focuses on gaining the fundamental physical insight of the high frequency vibration phenomena of structures. Different types of damages will be simulated on structures to investigate the sensitivity of the high frequency vibration signals to the damages. Both computer simulations and laboratory studies will be carried out to verify the applicability of the techniques in real world situation, which pave the way for a successful development and transition of an innovative technology to practical industry applications.

Required knowledge:

- Basic Matlab programming techniques
- Good knowledge of structural analysis

Project Code: S28 continued…

What you will learn in this project:

- Techniques of safety inspection. As an engineer, you will design and build the structures but the job is not done after the construction. The long term cost associated with maintenance and safety inspection of structures is high. It is a challenging area.
- Knowledge of finite element modeling technique and commercial finite element package, e.g. ABAQUS
- Experimental technique for safety inspection

There is an interesting article highlighting the current situation of Australian infrastructures.

Dollery B, Byrnes J and Crase L. (2007). The Infrastructure crisis in Australian local government: a proposed federal asset fund solution. Australiasian Journal of Regional Studies, Vol. 13, No. 1, pp. 3-19.

If you would like to know more about my research areas, please visit my personal website: alexng.zxq.net

Project Code: S29 Offered to: Honours & Masters
Primary Supervisor: Dr Alex Ching-Tai Ng
Project Title: **Development of a practical safety inspection technique using high frequency vibration of structures**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work: .....No
- Site visit(s):..... Potentially

Does the project follow on from a previous year?..... Yes | N/A

Research Project Description:

Nowadays, the issue of aging infrastructure is now recognised as one of the greatest challenges facing civil and structural engineers. Engineering industries in Australia have been fast developed in last two decades. A vast infrastructure, such as building and bridge, has been built. Structural aging can be a major issue in these industries and it can lead to casualties. Maintenance of structures is required to increase safety, reduce risk and minimise life-cycle operation cost of the structures. Different safety inspection techniques have been developed but the practical application of these technologies in real world situation is still a challenging issue.

The objective of this project is to develop a practical safety inspection technique using high frequency vibration phenomena of structures. The new development targets on addressing a number of practical situations in real world applications, such as requirement of baseline measurements, influence of temperature changes and measurement noise. This project involves both computer simulations and laboratory studies.

Required knowledge:

- Basic Matlab programming techniques
- Good knowledge of structural analysis

What you will learn in this project:

- Techniques of safety inspection. As an engineer, you will design and build the structures but the job is not done after the construction. The long term cost associated with maintenance and safety inspection of structures is high. It is a challenging area.
- Knowledge of finite element modelling technique and commercial finite element package, e.g. ABAQUS
- Experimental technique for safety inspection

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If you would like to know more about my research areas, please visit my personal website: alexng.zxq.net

Project Code: G01 Offered to: Honours
Primary Supervisor: An Deng
Project Title: **Hydraulic conductivity of partially saturated soils**

Is the research likely to involve:

- Computer Simulation:..... Potentially
- Lab work:.....Yes
- Field work: .....No
- Site visit(s):.....No

Does the project follow on from a previous year?.....Yes | 2013

Research Project Description:

Hydraulic conductivity, also known as water permeability of soils, is one of soil's properties, that describes the ease with which a fluid (usually water) can move through pore spaces or fractures. The results of hydraulic conductivity are important in assessing the flow rate and the consolidation in common geotechnical practices, as well as the barrier performance when landfill liner is concerned.

Often, hydraulic conductivity of saturated soils is concerned and widely adopted in practices. However, increasing practices and research indicate that soils are unavoidably presented in partially saturated state before the soils become fully saturated or after. Sometimes, the soils maintain partially saturated for a long term. In these circumstances, to apply hydraulic conductivity of saturated soils to partially saturated soils leads to significant overestimation of soil permeability and should be avoided.

This project will investigate the hydraulic conductivity of soils relative to its state of saturation. It will set up experimental apparatus to measure the hydraulic conductivity of a series of soils which are configured to different states of saturation. The result outcomes are expected to provide findings regarding the variation of hydraulic conductivity in response to the change of saturation degree of soils, and thus complement the current theory on water flow through soils. The investigation involves the continuation of previous laboratory work and needs light analytical skills.

Project Code: G02 Offered to: Honours
Primary Supervisor: An Deng
Project Title: **Stabilisation of expansive soils with tyre crumbs**

Is the research likely to involve:

- Computer Simulation:..... Potentially
- Lab work:.....Yes
- Field work:.....No
- Site visit(s):.....No

Does the project follow on from a previous year? ..... Yes | 2013

Research Project Description:

Expansive soils have been identified heavily deposited in major areas of Adelaide. The soils tend to expand as they absorb water and shrink as water is drawn away, which poses sever damages to residential and commercial foundations, as well as structures resting on the soils, e.g., heaving, wall cracking or even clear inclination. Stabilisation is required before the construction of structures to amend the expansive soils, or after the identification of the problems to remediate the soils.

Tyre crumbs show promising potential of stabilising the heave-up of expansive soils due to its nature of compressibility. The crumbs are also accessible at low cost and high volume by recycling the tyre disposals from the auto industry or disposals recycling centres, which makes the use of crumbs further attractive and financially viable.

This project will investigate the performance of tyre crumbs stabilised expansive soils, and compare the performance with those of other conventional stabilising scenarios. Research outcomes will involve the measurements and assessment of heave-ups and swelling pressures of typical expansive soils stabilised with tyre crumbs of different proportions and other additional stabilisers. The outcomes are expected to help prompt the adoption of tyre crumbs in stabilising expansive soils on a comparable performance. The investigation involves the continuation of previous laboratory work and needs light analytical skills.

Project Code: G03 Offered to: Honours
Primary Supervisor: Brendan Scott
Project Title: **Designing footings and retaining structures in unsaturated clay soils**

Industry Partner: Department of Planning, Transport & Infrastructure

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....Potentially
- Field work: .....Potentially
- Site visit(s):.....Yes

Does the project follow on from a previous year?..... No | N/A

Research Project Description:

As part of Adelaide's north-south corridor upgrade, DPTI are currently constructing a full scale trial section of a retaining wall in a section of South Road between Port Road and Torrens Road for future design and research purposes. This full scale trial provides a rare and valuable opportunity to extend our understanding of retaining structures and to identify the limitations of the assumptions underlying current retaining wall design practice, particularly when applied to soil conditions prevalent in Adelaide.

This 4th Year Project will aim to investigate better methods for designing footings and retaining structures in unsaturated clay soils. To do this one needs to find a "design" strength for the clay. This can be done by finding a relationship between the shear strength of the clay and the total suction of the clay, and the design total suction distribution of the clay, i.e. the lowest total suction values in the clay over the life of the structure.

The full scale trial retaining wall at South Road will be subjected to a leaking pipe at the end of an Adelaide summer to induce changes in soil suction. Wall deflections and soil suctions will be monitored over a period of several months. The data from this monitoring will become available from early in 2014 and will provide a great opportunity to compare (and calibrate) predicted against measured data. Predictions of soil suction distributions will be undertaken using a commercial software package, SVFlux. This project will involve site visits to the full scale trial retaining wall and potentially laboratory work as well. Key DPTI geotechnical staff will assist with the supervision of this project to ensure the project aims and direction are relevant to the full scale trial and for future project use along Adelaide's north-south corridor.

Project Code: G04 Offered to: Honours
Primary Supervisor: Brendan Scott
Project Title: **Quantifying the effectiveness of the 4-sided Impact Roller**

Industry Partner: Broons

Is the research likely to involve:

- Computer Simulation:.....Potentially
- Lab work:.....Yes
- Field work:.....Potentially
- Site visit(s):.....Yes

Does the project follow on from a previous year? ..... Yes | 2012

Research Project Description:

An impact roller is a non-circular roller consisting of 3, 4 or 5 sides that is towed behind a tractor that compacts the ground dynamically. Impact rollers are used in many mining and civil earthworks applications due to their ability to compact ground via a faster operating speed and to a greater depth of influence when compared to conventional circular rollers.

This project will investigate the effectiveness of a 4-sided roller via a laboratory (scale) model that will be purpose-built at Broons' in-house testing facility with the aim of quantifying the impact roller's performance for varying passes and in a range of different soil conditions.

Project Code: G05 Offered to: Masters
Primary Supervisor: An Deng
Project Title: **Numerical analysis on PVD-surcharge preloading combined consolidation**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work: .....No
- Site visit(s):.....No

Does the project follow on from a previous year?.....Yes | 2013

Research Project Description:

Prefabricated vertical drains (PVDs) are increasingly being combined with the use of conventional surcharge preloading technique to prompt the consolidation of highly compressible soils. The benefits of using the combined method involve the fast consolidation and the deep influential depth of the soil deposits.

Currently, the process of the combined consolidation is usually modelled based on small strain theory where soil properties are treated constant and uniform, which is not true in the case of high compressible soil deposits. For high compressible soils, the combined consolidation often leads to large strain, which affects, to a non-negligible extent, the nonlinear changes of the soil properties. The nonlinear changes should be taken into account by employing iterative computations when precisely modelling of the consolidation is expected.

This project will develop a numerical model regarding PVD-surcharge preloading combined consolidation. The model is able to account for the large-strain-induced nonlinear changes of the soil properties and to predict the consolidation characteristics of the compressible soil deposits. The project is a continuation of ongoing relevant research activities and involves mainly numerical simulations.

Project Code: G06 Offered to: Honours & Masters
Primary Supervisor: Giang Nguyen
Project Title: **Formulation for coupling fluid flow and cracking in rocks and concrete**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work:.....No
- Site visit(s):.....No

Does the project follow on from a previous year? .....No | N/A

Research Project Description:

The project will develop governing equations for the interdependency of fluid flow and fracturing in concrete and other geological materials (rocks). This involves analytical developments, while numerical solutions will also be utilised. Strong analytical skills are required along with background on two dimensional flow in geotechnical engineering.

Project Code: G07 Offered to: Masters
Primary Supervisor: An Deng
Project Title: **Modelling geofibres based composite geomaterials**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work: .....No
- Site visit(s):.....No

Does the project follow on from a previous year?.....Yes | 2013

Research Project Description:

Geofibre is one type of geosynthetic products, which is being increasing mixed with soils to solve geotechnical problems. The polymeric nature of geofibres makes them suitable, mainly in the form of reinforcements, for use in the ground where high levels of durability are required, e.g. retaining walls and embankments.

Currently, soils reinforced with geofibres are mainly analysed on macroscopic scale through experimental studies, which is not sufficient to be indicative of the soil-geofibre interaction on microscopic scale. As a result, the mechanical responses of soil-geofibre mixtures observed through tests are less confidently interpreted. It is thus desirable that the behaviour of the mixture on microscopic scale be delved into to complement the macro-observations.

This project will model the mechanical response of geofibre based composite geomaterials. Numerical simulation tool will be employed to mimic a variety of soil-geofibre mixtures and predict the interaction between granules and geofibres of the mixtures, locally and globally. The project is a continuation of ongoing relevant research activities and involves mainly numerical simulations.

Project Code: G08 Offered to: Honours
Primary Supervisor: Abbas Taheri
Project Title: **Developing a Multiple-step Loading Triaxial Compression Testing Method for Very Hard Rocks**

Is the research likely to involve:

- Computer Simulation:.....Potentially
- Lab work:.....Yes
- Field work:.....No
- Site visit(s):.....Potentially

Does the project follow on from a previous year? ..... Yes | 2013

Research Project Description:

Multiple-step loading (ML) triaxial compression test, allows evaluating shear strength parameters, i.e. cohesion and friction angle from a single specimen. The test consists of a series of consolidation and shearing steps, and in each step the axial loading is stopped or reversed before an eruptive failure. A literature survey indicates that details of loading histories comprising a sequence of consolidation and triaxial compression loading/unloading at different confining pressures are usually poorly stated by different researchers.

In this project, it is aimed to study the effect of loading history on shear strength and deformability properties of extremely hard rocks in multiple-step loading triaxial compression testing.

The study will be done mostly by triaxial compression testing in the laboratory. A series of single-step loading (SL) and ML TC tests will be conducted. ML TC tests will be done following two different amounts of unloading from different shear loading levels during TC loading, followed by an increase or decrease in the confining pressure to proceed to the next shear loading step. The effects of these different loading histories on the peak strength and stress-strain behaviour at respective steps in the ML tests will be studied.

In so doing, the following effects on the stress-strain behaviour at the respective current loading step will be investigated: 1) stiffening by cyclic loading due to elasto-viscoplastic properties; 2) effects of confining pressure on the stress-strain behaviour; and 3) damage effects that have taken place during preceding loading history.

Project Code: M01 Offered to: Honours & Masters
Primary Supervisor: Murat Karakus
Project Title: **Rock fatigue damage evaluation under cyclic loading using Acoustic Emission**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....Yes
- Field work: .....No
- Site visit(s):.....No

Does the project follow on from a previous year?..... No | N/A

Research Project Description:

In most civil and mining related projects, surrounding rocks of underground structures are generally subjected to dynamic loading due to active changes of stresses. Stress changes occur by introducing new excavations. Therefore it is essential to understand mechanical properties of rocks under dynamic loading. However, characteristics of dynamic failure are still not very well understood. In this project it is aimed to evaluate and understand fatigue behaviour using Acoustic Emission (AE) method.

Rock samples will be subjected to cyclic loading. Effects of frequency and duration of cyclic loading will be monitored with AE system developed in-house.

Project involves lab works and computer simulation.

Project Code: M02 Offered to: Honours & Masters
Primary Supervisor: Murat Karakus
Project Title: **Investigating the point of inflexion in Kaiser Effect for better estimation of in-situ stresses for various rocks**

Industry Partner: OZ Minerals

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....Yes
- Field work:.....No
- Site visit(s):.....No

Does the project follow on from a previous year? .....No | N/A

Research Project Description:

In-situ stress measurement prior to mining operations is an imperative stage in designing underground structures. The measurement will allow engineers to ensure stability of the underground structures by selecting an appropriate excavation techniques and adequate support systems. Acoustic Emission (AE) and Deformation Rate Analysis (DRA) can be used to estimate the in-situ stress reliably from the cored rocks in the laboratory. However, there are some inconsistencies found between measured and estimated stresses using AE and DRA. One of the main reasons for this discrepancy is locating the point of inflexion in both AE and DRA analysis. Point of inflexion in both methods becomes indistinct in some cases where we need to access in-situ stress information. However, for a new project there will be no in-situ stress information is available. This research aims to investigate take-off point, which indicates in-situ stress level in various rock types, and understand the mechanisms that cause the problem. Based on the mechanism to be identified, a new method will be developed to estimate in-situ stress level with high accuracy from cored rocks.

Project Code: M03 Offered to: Honours & Masters
Primary Supervisor: Dr. Abbas Taheri
Project Title: **Study on Application of Coal Mine Roof Rating (CMRR) Classification System to Design Support Systems in Underground Coal Mines**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work: .....No
- Site visit(s):.....No

Does the project follow on from a previous year?..... No | N/A

Research Project Description:

The support and control of unstable coal mines is an on-going problem for Australian coal mine industry. The estimation of strata stability is required not only during the feasibility study but also during the excavation and operating stages. Rock mass classification systems are then essential to quickly and reliably estimate the stability of the existing or required underground mines. There are few classification systems used in underground mine design. In this case, most Australian coal mines rely on Coal Mine Roof Rating (CMRR) classification system. However, CMRR is a rock mass quality (strength) indicator and not a roof stability indicator. As such it needs to be considered in combination with all of the other geotechnical design factors to determine mine design parameters such as support patterns.

It is aimed to study application of CMRR classification system to design support measures for underground coal mines. Case histories will be collected from a number of underground coal mines with a variety of geotechnical conditions, mine geometries, mine extraction methods and support patterns in a wide range of geologic environments. The stability of mines will be studied using numerical modelling tools such as PHASES or FLAC software and also with CMRR system. CMRR system will be modified to be used as a tool to directly estimate support measures required in underground coal mines.

Project Code: M04 Offered to: Honours
Primary Supervisor: Dr. Abbas Taheri
Project Title: **Progressive Damage Mechanism of Rocks subjected to cyclic loading**

Is the research likely to involve:

- Computer Simulation:.....Potentially
- Lab work:.....Yes
- Field work:.....No
- Site visit(s):.....No

Does the project follow on from a previous year? ..... Yes | 2013

Research Project Description:

Rocks in mining and civil engineering projects are subjected to cyclic loads during blasting, mechanical excavation and drilling. As a result, understanding the mechanical properties of rocks under both monotonic and cyclic loading is essential for the design and operation of these engineering applications. Rocks exhibit different stress-strain properties after a cyclic loading and a proper understanding of this behaviour is important to in the analysis of rock behaviour or the design of rock structures subjected to cyclic loads.

The effect of cyclic loading on peak strength and pre-peak and post-peak stress-strain relations will be investigated in great details using experimental study. A set of triaxial compression tests at different confining pressures applying unload/reload cycles, including varying number of cyclic loadings, different unloading amplitudes and unloading from different stress levels, during otherwise monotonic loading will be conducted. The results will be used to evaluate the effect of cyclic loading on the pre-peak and post-peak stress-strain behaviours and the peak strength during subsequent TC loading and to develop methodologies to predict rock behaviour.

A generalized damage model will be developed to predict peak strength and stress-strain relations under varying confining pressures during cyclic loading.

Project Code: M05 Offered to: Honours & Masters
Primary Supervisor: John Sturgul
Project Title: **Simulation and Animation of an Australian Surface Mine**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work: .....No
- Site visit(s):.....No

Does the project follow on from a previous year?.....Yes | 2013

Research Project Description:

Students will ideally have had vacation work experience at an Australian surface mine and will be familiar with how the mine works. (Only one student in the group need have this experience).

All students must be enrolled in Mine Simulation and Animation first semester.

Students will learn the GPSS/H simulation language and PROOF animation software. Students will construct a basic model of the mine as it is presently working and then pose and answer several "What if?" questions to determine how the mine might consider making changes to its system. These questions might be: Will a Dispatching system work? Will other travel paths result in greater production? Will in-pit crushers assist?

Project Code: M06 Offered to: Honours & Masters
Primary Supervisor: John Sturgul
Project Title: **Simulation and Animation of an Australian Underground Mine**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work:.....No
- Site visit(s):.....No

Does the project follow on from a previous year? ..... Yes | 2013

Research Project Description:

Students will ideally have had vacation work experience at an Australian underground mine and will be familiar with how the mine works. (Only one student in the group need have this experience).

All students must be enrolled in Mine Simulation and Animation first semester.

Students will learn the GPSS/H simulation language and PROOF animation software. Students will construct a basic model of the mine as it is working and then pose and answer several "What if?" questions to determine how the mine might consider making changes to its system. The model can be done using 3-D PROOF animation.

Project Code: M07 Offered to: Honours & Masters
Primary Supervisor: John Sturgul
Project Title: **Use of SXL Simulation Language for Modelling and Australian Mine**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work: .....No
- Site visit(s):.....No

Does the project follow on from a previous year?.....Yes | 2013

Research Project Description:

SLX is an advanced version of the well known discrete simulation language GPSS/H. It has been used only once before to model a working mine. Students will first model a known mine with GPSS/H (and PROOF software for the animation) and then re-do the same model using SLX. The advantages of SLX will then be discussed. It will then be possible to use PROF 3-D to model the mine in three dimensions.

Project Code: M08 Offered to: Honours & Masters
Primary Supervisor: Dr. Abbas Taheri
Project Title: **Developing a Drillability Model to Predict Drilling Penetration Rate in Different Drilling Situations**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work:.....No
- Site visit(s):.....No

Does the project follow on from a previous year? ..... Yes | 2013

Research Project Description:

The main objective of this study is to develop a Drilling Penetration Rate model that can predict drilling penetration rates for a range of user defined input parameters for typical open pit and underground blast holes.

A literature review will be conducted to find effects of various rock and drilling machine parameters on penetration rate and also to study existing methods available that can be used to estimate penetration rate.

Available data will be collected and analysed to quantify effect of each parameter on drilling rate. Then, a new methodology for calculating penetration rate for typical open pit blast holes and underground will be developed. The methodology will be examined and calibrated against available data. Finally, an Excel spreadsheet or a software package will be constructed that can model drilling penetration rates for a range of user defined input parameters for typical open pit and underground mine blast holes.

Good computational skills and knowledge of MATLAB software is essential is this project.

Project Code: M09 Offered to: Honours
Primary Supervisor: Emmanuel Chanda
Project Title: **Investigation into factors affecting the application of monorail systems in metalliferous mining in Australia**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....Yes
- Field work: .....Yes
- Site visit(s):.....Potentially

Does the project follow on from a previous year?.....Yes | 2012

Research Project Description:

Electric monorail systems are potentially more cost-efficient due to a range of factors: only the one system is needed for the transportation of workers, material and rock; and excavations for monorail haulage can be smaller and mined at much steeper gradients than for truck haulage – allowing comparatively high-speed underground development and production. The smaller excavation size also reduces the need for costly stability measures and, in another important measure for the health of mine workers, reduces the ventilation required to remove the considerable heat created by large excavations.

The aim of this project is to identify and evaluate mine design, operational and risk factors that impact on the application of monorail systems in hard-rock underground mining in Australia. It i expected that guidelines will be developed to deal with the factors. Results from a case study mine to be presented.

Project Code: M10 Offered to: Honours
Primary Supervisor: Emmanuel Chanda
Project Title: **A comparative study of computer simulation methods for haulage simulation in open pit mining**

Industry Partner: Kanmantoo Copper Mine

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....Yes
- Field work:.....Potentially
- Site visit(s):.....Potentially

Does the project follow on from a previous year? .....Yes | N/A

Research Project Description:

Computer simulation is a powerful tool for analysing the performance of mine haulage systems. There are several software packages for simulation modelling on the market and choosing the most suitable is not trivial.

The aim of this project is to compare GPPS/H and ExtendSim as simulation techniques for materials handling in open pit mining. Materials handling for the case study mine will be simulated using the two methods and comparisons made based on selected criteria.

Project Code: M11 Offered to: Honours
Primary Supervisor: Emmanuel Chanda
Project Title: **Optimum Number of Passes – An aid to initial analysis and preliminary load and haul equipment selection**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work: .....Potentially
- Site visit(s):.....Potentially

Does the project follow on from a previous year?..... No | N/A

Research Project Description:

For under trucked or matching load and haul systems: Efficiency of loading equipment increases with number of passes. For trucks productivity and cost benefits (efficiency) increase with reduced number of passes. These two effects are compensating to a degree dependent on the total truck trip time (one-way haul distance). The greater the truck trip time the lower the trucking benefits from reducing passes. There is likely a break-even point where the benefit to trucks from reducing passes is less than the benefit from increased loading efficiency. There are a number of other relevant factors including cost per hour ratio of loading machine to truck and changing queuing parameters with varying number of passes.

The aim of this project idea is to construct a nomograph or multi variable graph to provide a passes selection facility. One or more diagrams provide a facility for perceptual selection of load and haul equipment to be refined by more definitive analysis for feasibility studies. Ultimately a selection application (based on Excel) could be developed

With an initial perception of shape and form of ore body an initial pit form can be conceived. This provides a conceptual haul road profile. Using an average speed of 20kph provides a truck travel time. Add a selected fixed time provides a total trip time. Following through the relationships outlined delivers the number of passes. Ultimately the process leads to specific selection of loading equipment and trucks – including fleet sizes.

Project Code: M12 Offered to: Masters
Primary Supervisor: Emmanuel Chanda
Project Title: **Allocation and control of the mining truck fleet using dynamic programming**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work:.....No
- Site visit(s):.....No

Does the project follow on from a previous year? .....No | N/A

Research Project Description:

The mining process in a typical open pit operation involves drilling, blasting, and loading and hauling (transport). For load-haul operations most mines use dump trucks and excavators or shovels. For most operations the major cost component per unit of production is truck haulage (50% or more of operating costs). In response to this fact companies have developed haulage management systems including truck dispatch and control systems. The goal is to improve efficiency, solve dispatching problems and reduce costs.

The aim of this project is to improve on the dynamic programing model proposed by Fiva's et al (1973) for allocation and control of trucks at a large open pit operation. A suitable computer algorithm will be developed to implement the model and validated using real world data.

Dynamic programming is a mathematical technique for solving multi-step or multi-period processes so that the optimum use of resources can be determined. The aim is to allocate n trucks to k operating shovels at a mine in order to maximise the total production of the equipment.

Project Code: M13 Offered to: Masters
Primary Supervisor: Emmanuel Chanda
Project Title: **DEM- Simulation of ore transfer points in a block caving mining system**

Is the research likely to involve:

- Computer Simulation:.....Yes
- Lab work:.....No
- Field work: .....No
- Site visit(s):.....No

Does the project follow on from a previous year?..... No | N/A

Research Project Description:

Block caving is bulk mining technique that uses the action of gravity to fracture a block of unsupported ore allowing it to be extracted through the draw points. The full-gravity or grizzly system of block caving consists of the haulage level, transfer raises, grizzly level, finger raises, and undercut level. At present there is limited understanding of the ore flow process through these excavations such that current designs based on experience are suboptimal. The design of these excavations could be improved by discrete element modelling whereby the orientation, geometry and material properties are simulated to determine the optimal configuration.

The aim of this project is to simulate ore transfer points in a gravity flow block caving system in order to determine the optimal configuration that will maximise mine production and reduce hangups. A prototype scale model will be constructed with the ability to change the size and orientation of the excavations. Particles of rock fragmented to a reasonable size will be used to mimic the ore flow in the block caving environment.

A useful tool in the design of excavations in a gravity flow block caving system is computer simulation based on discrete element method (DEM) in connection with computer-aided design (CAD). DEM models will be compared to the experimental models in order to validate the results.