Faculty of Engineering

And Information Technology

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ABSTRACTS

CAPSTONE PROJECT PRESENTATIONS

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Broadway Campus

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The Design of Barriers for Noise Reduction - (12cp)
Nesar Ahmed - A15-016

Supervisor: Wenshan Guo
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Community noise or domestic noise has become a common issue for modern urban cities and rural areas. Constructions works, busy highways, rail tracks or airports are considered as the primary sources of community noise as known as domestic noise. Such as situations, local communities are very likely to be exposed when they stay in a long-term period. Use of noise barriers or noise walls, tree belts, earth mounds, porous roads, etc. can be considerably reduced the domestic noise levels.

This project studies on the impact of noise barrier on noise reduction. A typical noise barrier or noise wall near a highway is capable of reducing noise levels up to 5-15 decibels (dB) effectively, while a noise barrier formed from earth mounds or berms or combination of both can reduce 3 dB more than a vertical noise wall. A government body of authority, such as Roads and Maritime Services (RMS), confirms the necessity of a noise barrier in a particular location but it has to be accepted by the local community and city council due to aesthetics aspects.

This research found that noise barriers can be constructed by many types of materials such as earth, concrete, wood, etc. as long as the right density and rigidity. Types of noise barriers, the selection of materials, advantages and disadvantages, and the limitations of designing noise barrier are also discussed. A detail study has been carried out during entire project for better understanding the key factors, which determine a good design of noise barrier. In addition, field experiments were conducted to compare the efficiency of using noise barriers on highways. However, although noise barriers contributed to noise reduction and improved quality life adjacent to the highways, but all the traffic noise could not be eliminated. Overall, use of noise barrier can be one of the ways to reduce noise levels if only the design of noise barrier is incorporated with the design requirements.
Effective Design of Vertical Axis Wind Turbine for Minimisation of Acoustic Pollution - (12cp)
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Wind turbines have been a reliable source of renewable energy and improving their efficiency has been of great importance in reducing the pollution of the environment and the effects of Global Warming. Additionally there is an increase in demand of reducing costs to urban electricity consumption. A current developing solution is Wind Turbines which can be fixed to high city structures to allow facilities to generate their own green power.

The project aims to design and experiment on a micro scaled Vertical Axis Wind Turbine (VAWT) model which can be used to power UTS by replacing the current Wind Turbine on Building 11 with minimal noise of an acceptable level. This paper reports on effectiveness of number of blades, and incidence angles in a counter-rotating VAWT in Active acoustic noise minimization and performance enhancement.

The model produced was operated in a fan mode as single and twin rows. The variables changed included number of different pitch, and from a reference location measurements were taken of Air velocity (m/s), shaft-revolution (RPM); electric-power (W), amplitude of acoustic noise (dB) and its Central frequency (Hz). The Experimental results are plotted in the forms of dB vs. Tip Speed Ratio (TSR), dB vs. Central Frequency, and Efficiency or Coefficients of Performance COP vs. TSR.

It was noticed that in the double row operation active noise cancellation (ANC) was experienced which affected acoustic noises as output airflow between the blades changed. At a fixed TSR, dB decreased in the double row operations in comparison with the single-row operations, the reduction in dB increased at a higher TSR.

The results have found a great potential in the design of the VAWT and it is highly recommended for continuation of this project in the future.
In recent years, advancements and developments within the home environment have seen a fast trend of network compatible digital technology. These developments offer new and energizing opportunities to connect, monitor and control home appliance products through home automation systems. In addition, with the adoption of the Internet of Things (IOT) extension, connecting these products to the world wide web enhances the potential for remote access and monitoring from any device. This advancement, being available in the market for over three decades, hasn’t been widely adopted within society, more specifically the Australian market. This is predominantly due to several limitations found within home automation systems, making it costly to implement and difficult to manage.

Within the current scope of any home appliance (i.e. fridge, air-conditioning) and consumer electronic (i.e. audio / visual) products, exclusive protocols developed by the manufacture have restricted products being integrated and controlled from one system. This forces consumers to purchase various home appliance products from the same vendor if they were to consider smart home management. However, we are now moving towards an era in which users want interoperability and seamless integration of their products no matter which vendor manufactured the product.

As with all smart home appliance products, this project aims to support and enhance the life of the end user by allowing them to control, monitor and manage their appliance from the convenience of their devices. The primary objective of this project is to research new ways users can interact with their appliance through the use of a common protocol, without ignoring security. As there are a wide range of manufactures and product category types (i.e. lighting, fridges, TVs, etc.), this project will focus on the HVAC component predominantly utilising the Panasonic range. The core focus of this project is to design a universal bridging device that utilises a common protocol that won’t restrict end users to specific vendors for various components of their smart home system and will further allow integration with any home automation system available in the market.
The Application of Bagasse Ash as a Stabilizing Agent for Expansive Soils - (12cp)
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Soil stabilization is the modification of soil to enhance their physical and chemical properties to achieve a desired load bearing capacity to support roadways for the public. The growing cost of traditional stabilisation techniques and the need for more economical and environmentally friendly procedures used in road construction on expansive soils has prompted an investigation into the effect of agricultural wastes such as bagasse ash which is a sugarcane by-product. With further research and investigation I am proposing for an echo-friendly alternative to strengthening subgrade using a composition of lime and sugarcane bagasse ash. Recent studies have shown it to be an alternative suitable additive to lime only stabilisation, hence offering the industry tremendous savings in costs and minimal effects on the environment

This thesis details the effects of bagasse ash in combination with hydrated lime on expansive soils and determines whether or not the product can improve the geotechnical properties of subgrade for large road constructions. Tests were conducted in the laboratory strictly following the Australian standards in the soil samples to determine the engineering properties of treated samples such as the optimum moisture content (OMC), the maximum dry density (MDD), the unconfined compressive strength (UCS) and the Californian bearing ratio (CBR).

Since having worked in the road construction industry for the past 3 years, the importance of having a strong road is directly linked to the strength of its subgrade. The project will prove to be beneficial to the road construction industry as a low cost alternative to strengthening subgrade will be proposed as well serving as an economic and environmental benefit to the road construction industry.
Coal power plants in Australia are approaching and exceeding their designed decommission age and with no investment into large scale new plants, there is a need for greater maintenance to ensure the continued operation of current power plants. Turbine protection devices are essential equipment used to monitor turbine operating conditions and act to shut down the turbine if conditions approach dangerous levels. Currently no adequate means of testing the operation and reliability of Toshiba turbine protection equipment exists. This capstone project addressed this problem by devising a means to test different protection devices.

Comprehensive research was undertaken to determine the conditions required for testing. Minimal technical resources were available due to the equipment age, so field based measurements were completed to determine operating conditions and the required inputs and outputs of the protection devices. Design considerations/requirements were prioritised for safety, minimal effect on the environment and protection device damage prevention. For the design, suppliers were sourced and equipment costed for all parts required. A cost benefit analysis and three risk assessments were completed to outline the benefit and capital gain for Toshiba showing a profit for the system within four major outages of equipment overhaul.

A system has been designed that can replicate turbine operating conditions to test the responses of different protection equipment. The design incorporates varying inputs such as oil pressure, air pressure, vacuum and applied force. Due to differences in the design of turbine protection equipment at different power plants, the system has been designed to be flexible and work with variations in equipment sizing.

The outcome of this capstone project is a design proposal which provides means to build a testing device for safely testing turbine protection equipment. The project explains how the testing station would work, equipment required and how to use the system correctly.
Micro Aerial Vehicle Simulator - (12cp)
Edsel Aquino - A15-179

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Unmanned Aerial Vehicles (UAV) are becoming one of the newest emerging and utilized technologies in the last decade. Although the focus since its conception has been on the military applications of the technology, there has been a growing interest in the research and development in the commercial and private hobbyist applications of such vehicles.

Micro Aerial Vehicles (MAVs) are smaller, light-weight, and a more affordable type of UAV that can be fitted with an array of sensors and devices that make them suited to many different applications. The main characteristic of this type of technology is the ability to fly near autonomously with the help of a Ground Control Station (GCS). This type of autonomous navigation relies on the gathering, analysis and transmission of sensor, environmental and locational information to make informed internal decisions to control flight dynamics.

The focus of the project was to investigate and develop a novel approach to Hardware in the Loop (HITL) simulation for the PIXHAWK Autopilot System that would allow rapid prototyping and testing by monitoring the usable output of the system and reinjecting simulated data for further processing by the PIXHAWK Autopilot.

The project report includes a look at contemporary simulation techniques previously employed in MAV simulation, an overview of how the autopilot control system works, a detailed look at the architecture required for a simulator and details of the techniques and system employed in the development of this project. It concludes with a summary of the findings, limitations and discussion on future development of the simulator concept.
Development of SCADA System - (12cp)
Yu Bai - A15-184

Supervisor: Steven Su
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SCADA (Supervisory Control and Data Acquisition) system is used to operate with coded signals over communication channels and to provide control of remote equipment. Usually SCADA system uses one communication channel for one remote station. But it can also control huge number of remote stations by different communication channels. SCADA system is able to combine with a data acquisition system that acquires information about the status of the remote equipment and to display and record results. This control system is used in industrial control system (ICS). Industrial control systems are computer-based systems that monitor and control industrial processes that exist in the physical world. SCADA can be large-scale processes that can include multiple sites, and large distances. This is the most obvious difference with other industry control system.

SCADA system as an industrial automation control system can be used to many modern industries, including Energy System, Oil and Gas system, Transportation system, Food and Beverage system, Power system, Water and Waste Water system, Manufacturing system, Recycling system and many more.

In my project, I use the software called CitectSCADA7.50 (7.50 is the edition) to build a SCADA system that can control the circuit board. This board is established with fan, heat resister, temperature sensor and other components such as resistors, capacitors and amplifiers that are used to connect the power supply to the devices. SCADA system can acquire the temperature signal and control the fan and heater devices to achieve the target temperature that can be set in software by ourselves.
Engineering Geomorphology and Slope Stabilization for Road Construction - (12cp)
Asbin Bashyal - A15-029

Supervisor: Ken Halstead
Assessor: TBA
Major: Civil Engineering Major BE and BE(DipEngPrac)

Due to recurrent slope failures of roads in mountainous and hilly regions, the task of construction and maintenance of roads is very difficult in such areas. As a consequence, it leads to road closures, adversely affecting the lives of people in the area as deliveries of necessities and services become redundant. Thus, this project aims to investigate the extent of problems as well as finding viable engineering solutions to problems through the use of local resources, local manpower and limited budget. I aim to compare the different engineering techniques such as incorporating bioengineering methods - vegetative crib walls and brush layering.

The project aims to analyse the road design mechanisms in hilly and mountainous areas, where they are highly susceptible to landslides and slope failures. Furthermore, the project aims to investigate the reasons for slope failures, which, consequently lead to road failures. For example, causes such as heavy rains, slope angle, climate and slope material contribute towards slope failures. Similarly, other causes of slope failures such as instability of the ground will also be analysed. The project will also incorporate recommendations to improve the majority of the slope failures that occur at cuttings. Slope stabilisation mechanisms such as the construction of retaining walls, rock bolting, and removal of rocks will also be discussed.

Furthermore, this project will also incorporate bioengineering methods as possible solutions to improve slope stability. As the project focuses on unstable roads in rural areas, there will be major constraints on budget, technology and other resources required to achieve desired outcomes. Hence, the project will also analyse the constraints and aim to find viable solutions given the circumstances. The project will also include case studies to analyse the suitability of implementing the techniques and their effectiveness in achieving the desired outcomes.
A Feasibility Study Determining the Most Appropriate Bridge Design for Country Bridges that are Reaching the End of their Serviceable Design Life; Comparing Current Engineering Advancements Against a Typical Reinforced Concrete Solution - (12cp)
Oliver Bauer - A15-164

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Bridges provide a profoundly important function within society as they help connect communities, invoking a change in the way we interact as a society and conduct work. Country bridges have historically been constructed of timber and in the majority of cases are reaching the end of their serviceable design life.

Bridges, like all structures have a limited serviceable life and with approximately 2000 timber bridges within the local government network, there is an increasingly prevalent challenge for NSW to appropriately replace and upgrade regional bridges. There is a current engineering need for an effective design solution that encompasses both the bridge engineering requirements as well as the constraints imposed on projects in regional locations.

Through an assessment of strength, constructability and durability a desktop assessment has been undertaken to determine whether modern bridge engineering materials and techniques can rival known engineering strengths of reinforced concrete solutions, as well as provide economic savings across the vast number of bridges that will require replacements. Alternative materials have been explored that can provide lightweight and construction friendly solutions.

Bridges present a large investment from stakeholders as well as a major impact to the community, reinforcing the need for effective design solutions that meet both the serviceability and economic requirements of the asset owner, as well as the current attitude of the community towards project aspects such as environmental impact and social responsibility. This capstone has illustrated the advancements in modern engineering materials and their progression towards viable engineering solutions, as well as their suitability as options that focus on environmental impact and sustainability.
Transfer Chute Design: Fundamental Design Theory, Virtual Testing and True Performance Outcomes for Bituminous Coal (12cp)
Stuart Bowling - A15-074

Supervisor: John Dartnall
Assessor: TBA
Major: Mechanical Engineering

This capstone reports on the author’s findings and application of the design methodology behind conveyor to conveyor transfers of Bituminous Coal found in mining and bulk material handling applications. It applies the research and setting of ideal geometries for generating optimized chutes specifically for coal, as well as highlighting other issues that may influence in their design; notably items such as the handling of saturated fine particulates, maintenance issues, serviceability requirements, operational expectancies and safety. It discusses common faults and how to identify and reduce them in the design period.

The author then tests these design principles via a computational testing methodology known as the Discrete Element Method (DEM), which utilizes 3D modelling and a time based positional calculation for a series of simulated particles representing a body of media in transfer. This DEM requires a detailed calibration of the parameters that affect the behavior of these particles to best match the real world equivalent. This document discusses a testing methodology for a calibration set-up that mimics coal for the DEM software Chute Maven. This process involves matching virtual performance outcomes to both real world, laboratory certified data and to values established by existing mathematical formulas.

The final stage of this capstone is to apply the lessons learnt from the DEM testing method to create a new calibration setting, and then directly compare it to past design data that was formed via a different method. Both sets of calibration will then be analysed against a series of real world results documented from an existing DEM designed transfer chute; CV1097 at Ulan Coal mine, near Mudgee, NSW, to validate or assess how accurate the DEM can be, and where improvements could be made for future work.
Compression Strut Action in Deep Beams - (12cp)
Matthew Cameron - A15-136

Supervisor: Shami Nejadi
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Deep Beams are a specific type of beam with various important properties that set them apart from simple beams. A deep beam is defined by the shear span to depth ratio which is 3 for simply supported members and 4 for continuous members. The reason for this is due to the beam having significant dimensions in 2 directions, the behaviours of the internal actions changes and non-linear distributions, or D-regions, are formed. This means that the reinforcement in the beam will need to be designed to take these actions using the strut-and-tie method. This method designs the reinforcement like a truss system to properly distribute the load across the deep beam and to the support.

The purpose of this project is to assess the ability of deep beams in structural situations. Due to their unique geometry, deep beams distribute loads and moments differently to ‘one-dimensional’ beams. It is because of this property, they can be much more adapt to certain loading situations. The situation under assessment for this project is how a deep beam will perform as a structural shear wall. The example used is for an elevator shaft in a multi-level building. This is a form of shear wall that is common in structural design.

This has been modelled through the use of the Finite Element Analysis software Ansys. Through the use of the Ansys model and analysing the results, an assessment has been made as to the validity of using deep beams as shear walls. From this recommendations were made as to how appropriate deep beams are for use as shear walls along with results to support this conclusion.
An Experimental Investigation and Cost-Benefit Analysis to Determine Potential Advantages of Using Reclaimed Car Tyre Rubber in Western New South Wales Cohesive Subgrades – 12 Credit Points - (12cp)

Thomas Carruthers - A15-158

Supervisor: Ken Halstead
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Based on a study conducted by Hyder Consulting in 2010, over 48 million end-of-life equivalent passenger unit tyres are introduced into waste disposal streams annually in Australia, of which 16% are recycled to be transformed into rubber derived products or rubber derived fuels. One rubber derived product is crumbed rubber aggregates.

Crumbed rubber has previously been used as an additive in asphalt and bitumen sealing for road wearing courses. The use of crumbed rubber is however not widespread.

The objective of this project was to determine the potential advantages of using reclaimed car tyre rubber in Western New South Wales' cohesive subgrades by the blending of crumbed tyre rubber particles with soil samples and subjecting them to California Bearing Ratio (CBR) testing.

Three soil samples and two representative crumbed rubber aggregate size ranges were selected for testing, the former being 4-7 mm and 8-15 mm. The crumbed rubber particles were blended at 5 and 15% by weight. Consequently, a cost-benefit analysis was completed to determine whether it would be a beneficial practice, using hypothetical granular pavement design as the basis for analysis.

It was determined that crumbed rubber aggregates are not a positive contributor to mechanical stabilisation in Western New South Wales cohesive soils. The blending of crumbed rubber caused a reduction in the maximum dry density (MDD), whilst the optimum moisture content varied based on the soil type which contributed to mixed results regarding the swell characteristics of the soil. The CBR values of the soils were significantly reduced.

The use of crumbed rubber as means of mechanical stabilisation would not be recommended for the improvement of cohesive soils under loading. Researching the loading benefits and implications of introducing whole tyres into subgrade pavement layers could be done to develop a more sustainable road construction model than current practice.
Stability Analysis of Truss Structures - (12cp)
Nathan Challita - A15-139

Supervisor: Emre Erkmen
Assessor: Ali Saleh
Major: Civil Engineering Major BE and BEDipEngPrac

Trusses are structures that consist of straight two-force members, organized such that the assemblage forming triangular components acts as a single load carrying unit. These members are stressed axially in either tension or compression and upon reaching excessive values, cause deformation and a structural member to fail leading to a partial or overall collapse in the structure.

Truss bridges are load bearing structures often composed of parallel coplanar trusses. Corresponding structural collapses have a number of negative societal, economic and environmental effects. Thus, it is an important consideration in designing trusses to understand the significance of conducting a stability analysis.

In general, truss structures are often comprised of a number of elements and in order to analyse as a whole requires extensive mathematical analysis. When dealing with larger structures, these equations are numerous and can be complicated and tedious to calculate by hand.

Thus, the purpose of this project was to develop a MatLab program able to analyse any given truss structure through the use of the stiffness method and eigenvalue analysis by Bifurcation. The user inputs data on the structures geometry, loading and support conditions to determine the member forces and deformations, along with modes of buckling.

Two programs have been developed:
• 2-dimensional truss analysis program
• 2-dimensional structural analysis program with beam elements

The limitations of the truss analysis program are in its inability to model the local buckling shapes of its members, as dividing a bar into several truss elements would lead to an unstable structure. Thus, the purpose of the beam element program is to model the local buckling modes. This report will outline the methods and calculations used and present the results found in the analysis between the two programs for different truss structures.
Designing a Driver Stage for a Brushless DC (BLDC) Motor without Sensors - (12cp)
Cheuk Chan - A15-117

Supervisor: Steven Su
Assessor: Li Li
Major: Electrical Engineering Major BE and BEDipEngPrac

The capstone is to focus on replicating an idea (designing a driver stage for a BLDC motor) as an electrical engineer; this includes researching, implementing concepts learnt from multiple subjects, reading and understanding datasheets of components and learning new programs and processes.

Brushless DC motors provides a list of advantages over brushed DC motors:
- High torque to weight ratio.
- More torque per watt (increasing efficiency)
- Increase reliability
- Reduced noise
- Longer lifetime (no brush and commutator erosion)
- Elimination of ionising sparks from the commutator
- Overall reduction of electromagnetic interference (EMI)

With the current technology, it is possible to design the driver stage of the BLDC motor via programming a microcontroller to control the activity of an integrated circuit (IC). In the capstone, issue occurs when controlling a senseless BLDC motor using back electrical motive force (EMF), where on low revolutions per minute you will obtain choppy steps causing the BLDC motor to stutter. To overcome the choppy steps, we feed a sinewave modulated pulse width modulation (SPWM). Using a lookup table we can detect which quadrant of the BLDC motor to energise, which solves low speed drive of the BLDC motor. Finally after the prototype is completed a printed circuit board (PCB) will be produced as a final product.

Such implementation will allow engineers and developers to utilise the driver stage of the BLDC motor in different applications including:
- 3-axis BLDC gimbal
- Transport
- Heating and ventilations
- Aeromodelling
- Positioning and actuation systems
- Radio controlled cars

As demonstration on the functionalities of driver stage of the BLDC motor at low speed, another microcontroller will help provide the speed and direction of rotation of the motor.
This project concerns the lifetime carbon emissions in the automotive industry and the impact of future trends. In this study the lifetime carbon emissions of passenger vehicles are identified and examined in the Australian context. Current trends within the Australian fleet and Australia’s current energy generation/petroleum sources are reviewed to determine the indirect emissions in the automotive industry. Future trends are outlined for both energy generation and vehicle propulsion and the impact they have on the lifetime carbon emissions of passenger vehicles in Australia. The difference in the environmental impact of various powertrains have been compared including battery powered fully electric, hybrid electric, fuel cell electric and internal combustion powertrains using fossil and alternative fuel sources.

Within this study a methodology to apply Well to Wheel (WTW) analysis to the Australian fleet is created. It involves using statistical data and taking into account the unique drive cycles and energy generation characteristics used in different regions of Australia. It compares the impact of changes that new and emerging technologies will have on the future WTW emissions of the Australian Fleet.

Climate change is becoming a more prevalent factor with today’s society and is changing the priorities for engineering requirements within the automotive industry rapidly. Looking at the developments in the industry and the corresponding impacts that they have on carbon emissions is vital for identifying the best methods for further development. WTW analysis and its implementation across the Australian fleet can greatly assist in this endeavour as the carbon emission impact across their entire lifecycle of automotive vehicles can be examined.
Study into Induction Motors from a Thermal Perspective - (12cp)
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Major: Electrical Engineering Major BE and BEDipEngPrac

Induction machines represent the workhorse of global power conversion; they usually operate as motors but can be used as a generator. Being relatively cheap and rugged when the squirrel cage configuration is used, induction machines being quite scalable from watts to megawatts and have found their place in industry as pumps, traction motors and etc. However, in today’s world, with ever increasing loads, the size required to meet the demand can become an issue.

Modern design techniques aim to reduce the size of machines, which decreases their cost of manufacture and in some applications this is highly desirable, particularly in applications such as automotive drives. In addition, low loss and high flux magnetic materials has led to size reduction. Recently, methods have been developed that enable cage induction motor rotors to have cast copper cages as well as aluminium cages. A final avenue of improved design techniques is to address the cooling in a more methodical design procedure so that the machine can be cooled in a more effective way.

The focus of the project is twofold. Firstly, to investigate the different methods in which liquid cooling can be applied. Secondly, to compare different designs of machine in order to realise smaller and more compact machines whilst not losing performance and efficiency. These point both need to carefully address the use of materials and the cooling. One of the key aspects of the project is to compare air cooled machines both naturally cooled and air forced types to forced and fluid cooling.

To aid these goals, the project will use the computer modelling software Motor-CAD from Motor Design Ltd, UK, and this simulates the various performance and thermal aspects of the motor. Initially industrial motors will be addressed but then more arduous designs, such as automotive machines, will be investigated.

The software will be benchmarked using an existing motor which will be tested with running light and short circuit tests to obtain equivalent circuit parameters and look at thermal performance.
Effect on Column Size of Braced VS Sway Frames in Retail Developments up to Four Storeys - (12cp)
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Supervisor: Anne Gardner
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The stability of a structure depends on the type of the frame that the structure has been designed in. There has been a debate about the structural integrity of braced frames compared to sway frames for both material types, steel and concrete.

The purpose of this project is to understand the relationship between the types of frames and the column cross-sectional sizes. This project studies the effects on steel and concrete column sizes when they are designed in braced and sway frames and compares the columns of steel braced frame to steel sway frame and the columns of concrete braced frame to concrete sway frame. For this reason, design and analysis software Microstran is used to model the structures to compare the internal actions of columns in braced and sway frames and for checking the stability and serviceability of columns.

The purpose of comparison is to determine the optimized design approach for the steel and concrete frames. The analysis allowed to estimate the sectional sizes of columns for a retail structure and the required sizes of sections indicate the effects of braced and sway frames on column cross-sectional sizes. Australian standards such as AS 4100 and AS 3600 are used to approximate the design load and to check the member capacities.

This project demonstrates the design and analysis of retail structure with four different frames. This research intends to assist in understanding frame and column relationship for optimized design and for understanding the advantages and disadvantages of using braced and sway frames in different loading situations. This research also provides a base for further research in the same area.
Proof of Concept: The Biefeld-Brown Effect - Electro-Hydro Dynamics (EHD) (primary), Gravity Wave Generation (secondary); Harnessing Conventional Energy from a Biefeld-Brown Generator - (12cp)
Nicholas Chetty - A15-065

Supervisor: David Dorrell
Assessor: Youguang Guo
Major: TBA

There is still little literature on the Biefeld-Brown Effect and further research is needed. This experiment seeks to investigate this outcome using reliable engineering practice. The technology in its full realization is a drive/generator that harnesses naturally occurring energy around the earth so that more power comes out of the system than goes in. NASA is incorporating part of this phenomena into propellant-less motivators for future spacecraft technology. This project endeavours to develop a Biefeld-Brown Generator and investigate whether it can produce conventional power.

In the experimental rig, a HV power supply is constructed and the rotational device is mounted on it. The rotational device is able to ionize the air surrounding the cathode and anode inducing EHD (electro-kinetics). A secondary effect uses a localized gravity field (electro-gravitics) around the positive electrode making it possible to exploit (via the shape of the asymmetric capacitors) the fast waning gravity waves; it is envisaged that the wave amplitudes will be sufficient such that their effect (thrust provision) will be measurable, and impart forward motion. This phenomenon is still contentious. The undertaken research combines, for the first time, EHD and out of phase gravity into the one test rig. It will verify that power can be extracted from the model. The experiment will be repeated for different voltages, air gaps in the asymmetric capacitors, and times up to 120 seconds.

Socio-politically, this technology could add another energy source into the energy mix. It can be considered as a renewable energy source and one of the few that is not solar related. The aim of this is to eventually have a device that will be able to translate its energy into the grid system. To operate it does require high voltage but this is readily available on the grid. This experiment is a proof-of-concept machine and will be the basis for other devices that will be built using sound engineering design and incorporating the experiences obtained from this and other early stage prototypes. It will enable further research into this area of electromagnetism, with the aim of having a higher conversion factor (electrical power in against electrical power out) and hence sustainable in the long run.
The need for efficient water treatment derives from the scarcity of clean water. Areas which receive little rainfall must opt to extract water from saline natural water resources that contain mixed minerals with unsuitable concentrations of fluoride for drinking water purposes. One solution that can make water available and to treat such sources is a direct contact membrane distillation (DCMD) technology. DCMD, a low energy thermal membrane process is a promising alternative treatment technology. DMCD treatment process enables to produce high quality drinking water with a vapour distillation process in a sustainable manner with the usage of solar energy.

The aim of this project is to test the operation performance of DCMD system in a laboratory setting. This would enable to access the feasibility of this system for treating ground water. This project is carried out in two fold. Firstly, a literature review is conducted to critically analyse and understand the mechanism of this technology through available studies. A review of known studies encompasses the experimental stage, which utilises a pilot scale of the DCMD technology provided by the University of Technology, Sydney. The experiments focused analysing the performance ability of DCMD with different feed solution concentrations and composition including salinity (NaCl), calcium sulphate and fluoride. Analysis included the comparison between feed influent and effluent concentrations, operating parameters such as feed temperature, cooling temperature and feed flow rate. The operating parameters were evaluated in terms of water production rate (flux) and water quality including total dissolved solids (TDS) and membrane hydrophobicity (contact angle).
Energy Losses Associated with Overflowing Storm water Pits - (12cp)
Ray Crook - S15-017

Supervisor: Jaya Kandasamy
Assessor: Saravanamuth Vigneswaran
Major: Civil and Environmental Engineering Major BE and BEdipEngPrac

During large storm events the design capacity of piped drainage systems can easily be exceeded. In these instances, stormwater tends to overflow out the top of stormwater pits. Overflows can also occur due to blockages in pipes and pits, or may be induced deliberately as a way of diverting flows for purposes such as pollution treatment. Whilst the location of this overflowing pit may be taken into account in the design of the stormwater system, the energy losses associated with the water surcharging out of the pit are typically ignored or conservatively assumed. The energy losses that occur are significant because they can influence the water levels in other parts of the stormwater system. Because the intended use of a stormwater pit is for the inflow of stormwater, the effects of water surcharging out a stormwater pit are less known than the way that water enters a pit.

This project investigates the hydraulics of an overflowing stormwater pit, so that the energy losses associated with overflowing pits can be better understood. A physical model of a stormwater pit has been constructed in the UTS Hydraulics Laboratory so that experiments can be run where water is pumped through a pipe and into the pit where it overflows out the top. The data generated from these experiments includes the water pressure at multiple points in the model which varies depending on the flow rate and configuration of the stormwater pit. Several different types of outlets have been attached to the top of the pit to determine what impact they have on factors such as pressure, energy loss and the height of the overflowing spout. Through the analysis of the results of the experiments, empirical relationships can be developed between the configuration of the stormwater pit and the resulting energy losses.
Modelling and Re-Engineering a Two-Speed Planetary Automatic Transmission - (12cp)  
Frederik Crous - A15-174

Supervisor: Paul Walker  
Assessor: Holger Roser  
Major: Mechanical Engineering Major BE and BEDipEngPrac

It is well known globally that climate change and waste products are a major issue for the future of our home, the earth. The Chinese government, through subsidies, has made itself a goal of increasing plug-in electric vehicle (PEV) use amongst its population as a means of reducing environmental impacts. High costs are however still impacting PEV adoption. Innovative solutions are required to reduce the cost of producing PEV’s thereby making them more accessible to the population. Solutions should also consider the existing waste of the automotive industry.

This report will document a solution of taking an existing planetary automatic transmission used commonly in Australian vehicles and repurposed for use in electric vehicles. The transmission was disassembled and its components measured and modeled using CAD software Solidworks. The models were then used to redesign the transmission, removing unnecessary parts and adding a small number of parts as required. A new housing was designed for the smaller, more compact gear train and an efficiency study was completed.

The new transmission, designed for use in PEV’s, is a two-speed transmission. Using an existing transmission to build from has limited the need for new components, thereby effectively recycling the older transmission. The efficiency study showed that efficiency gains are acquired by removing superfluous friction loss components such as clutches and bearings as well as gains by reducing the overall weight of the transmission. A new housing design has contributed by allowing for a smaller more compact transmission.
A Comparative Model of Engineered Timber and Conventional Building Materials -
(12cp)
Christine Daaboul - A15-151

Supervisor: Emre Erkmen
Assessor: Rijun Shrestha
Major: Civil Engineering Major BE and BEDipEngPrac

An increasing industry push towards sustainable development in recent years has resulted in extensive research into the development of engineered timber technologies, including cross-laminated timber (CLT) and laminated veneer lumber (LVL). These new building materials have the structural capacity to replace conventional building materials, such as reinforced concrete.

However, the transition into sustainable development is not only influenced by economic feasibility, but also by industry awareness of the alternate structural systems than can replace conventional building materials. Assessing engineered timber in comparison to conventional reinforced concrete systems is important in the early stages of a project's design development, both to quantify the benefits of sustainable materials and to determine an economically viable solution for the project.

The project involves the development of a program, using Microsoft Visual Basic for Applications (VBA), as a tool for designers and developers to compare different construction materials and systems in regards to sustainable, economic and social performance. Using published literature and external case studies (comparing equivalent timber and reinforced concrete building structures), the program can instantly compare building materials for basic user-provided data (development type, number of floors and gross floor area).

The intent of the program is to encourage designers and developers to consider the economic, environmental and social benefits of implementing structural timber solutions in the early design development phase of commercial and multi-storey residential projects. The simplicity of the program means that any user can interpret the data, even without technical knowledge in structural design. Through an increased awareness of alternative sustainable building materials, the industry can transition towards sustainable development.
Benefits and Limitations of Polymer Modified Bitumen on Australian Roads - (12cp)
John Dau - A15-261

Supervisor: Ken Halstead
Assessor: Ali Saleh
Major: Civil Engineering Major BE and BEDipEngPrac

This thesis will discuss the benefits and limitations of Polymer Modified Bitumens (PMBs) used in both sprayed sealing and asphalt applications in Australia. The Australia history of bitumen polymer modification and development of the specification over the last two decades has been chronologically described. Furthermore, the advantages and disadvantages of popular polymer modifiers including Styrene-butadiene-styrene (SBS), Ethylene-Vinyl Acetate (EVA) Polyethylene (PE) and Crumb Rubber have been discussed to enable a better understanding of their rheological properties and how they enhance the properties of standard bitumen. Polymer Modified Bitumen is considered a multiphase system and focus has also been placed on bitumen chemicals composition and colloidal structure.

In addition to the reported benefits, many limitations on the use of PMBs including the limited storage stability of all PMB types, the susceptibility to segregation during storage and transportation and the incompatibility between common polymers and bitumen on a chemical level have been discussed. In regard to these issues, this paper has given a review on technical developments for alleviating those drawbacks through research into sulphur vulcanisation, the introduction of antioxidant compounds and hydrophobic clay minerals to PMB mixtures and functionalisation processes that promote improve compatibilities between polymers and bitumen bases. However, further efforts are required to finetune these developing treatments and particular efforts are now required to develop ways of altering specific properties of PMBs without degrading performance in other areas.

Since it is currently challenging to perfectly achieve all expected PMB properties at the same time, it is recommended that future research on bitumen polymer modification focuses more on function development towards enhancing: adhesion with aggregates, long-term performance and recyclability. At the moment, research into functionalisation seems to be the most promising area for future development and may yield new methods of furthering the performance of PMB in both storage conditions and after placement on Australian roads.
Design of Temporary off Grid Power Generation for Refugee - (12cp)
Pouyan Ebrahim Aski - A15-239

Supervisor: Li Li
Assessor: Youguang Guo
Major: Electrical Engineering Major BE and BEDipEngPrac

Natural disasters have put a lot of people’s lives into danger recently. This can be anything from an earthquake and flood to a war. Thousands of people will lose their homes and facilities and what united nation can provide them is the minimum household facility in order to keep them alive until they get located into a proper area for living. This project is going to go through a minimum requirement of refugee camp in terms of electricity. As the technology has progressed recently, people at refugee camps will need some electricity for charging devices as well as lighting for their tents or camps that this project will give a design of a DC solar system that can meet their minimum requirements.

The capstone report will provide discussion of available technologies for temporary off-grid power generation for refugee camps and present an in depth analysis of suitable photovoltaic systems. It will look at emerging energy storage solutions and provide options to future proof photovoltaic systems.

In addition to this document, instead of having a huge system for the whole refugee campus, I have provided a full design of an off grid DC solar system which will work individually for each tent. This system can be adjusted in terms of numbers of solar modules based on the capacity of each campus. The design provides a calculation of the demand, solar module and battery selection, MPP and MPPT based on perturb and observe algorithm, direct control method for MPPT and a brief discussion about battery controller charging and discharging. The direct control is inside the DC/DC converter and will adjust the system output based on the desired voltage and current for the system.
Design of Multistorey Building with Comparison of Reinforced Concrete and Cross Laminated Timber - (12ep)
Osman El-Zohbi - A15-199

Supervisor: Rijun Shrestha
Assessor: Yancheng Li
Major: Civil Engineering Major BE and BEDipEngPrac

Due to expanding world population; cities have become more densely populated and are being pushed towards expansion of infrastructure starting with the construction of multi-storey and multi-residential dwellings. These types of construction are possible due to the accessibility of cheap and convenient building materials such as concrete and steel. However, new building materials such as Cross Laminated Timber (CLT) are striving to enter the construction industry to reduce labour costs and provide a more renewable source of construction materials which offer a similar strength in terms of properties.

CLT was initially developed in Europe and is becoming increasingly common since it is a suitable substitute to concrete. It is a new innovation to timber engineering as it offers enhanced properties at a cost-competitive price. Currently, Europe and New Zealand manufacture Cross Laminated Timber. Handbooks for CLT design are available from FP Innovations utilising American and European standards in their calculations. Designing buildings with CLT reduces construction time enormously as CLT is light in weight and simple to assemble making it an attractive material to use.

This group project aims to compare Cross Laminated Timber with Reinforced Concrete by assessing its feasibility as a construction material and its design properties while attempting to design an eight storey building. The project aims to research as well as learn about the intricate and detailed considerations needed to design a complex multi-storey building. This project will focus on utilising and learning how to use engineering software that is currently used in the industry to model and design the structure, as well as investigate the theory behind CLT.
Design, Build and Test a Dual Axes Reflective Mirror Solar Tracking system for UTS Building 11 PV modules - (12cp)
Wassim El Danawi - A15-196

Supervisor: Jafar Madadnia
Assessor: Michael Behrens
Major: Mechanical and Mechatronic Engineering Major BE and BEDipEngPrac

This capstone thesis was prompted to design, build and test a mirror tracking system for spring semester. The project will be used in conjunction with the existing solar panels on the roof of building eleven in order to achieve maximum solar power energy.

Renewable energy systems on UTS-building 11 have been designed for fixed operational conditions, resulting very poor performance. There are a large number of renewable energy systems on the roof of the building 11 and this project has focused on solar-energy-Photovoltaic. This project aimed to convert the fixed design-conditions for UTS-PV-modules into flexible design conditions using mirror tracking (similar to the Fraser-building in the Broadway), hence improving operational performance of Photovoltaic modules.

The purpose of this project is to increase the electric-conversion-efficiency of solar panels. A three dimensional, dual axes reflective mirror tracking system was designed, built and tested at UTS improving the operation period from three hours operation to up to 12 hours operation. The efficiency of PV has also improved from 10% (at the design PV angle of 30 degrees) to a normal incidence of 90 degrees using the mirror tracking system. The prototype is designed to rotate horizontally and vertically at the same time to increase reflective solar rays. Moreover four light dependent resistors have been used to increase system’s accuracy.

Finally, recommendations are made for future generations of students to follow.
Design of Multistorey Building with comparison of Reinforced Concrete and Cross Laminated Timber (12cp) - (12cp)
Omar El Hawat - A15-192

Supervisor: Rijun Shrestha
Assessor: Yancheng Li
Major: Civil Engineering Major BE and BEDipEngPrac

Due to expanding world population; cities have become more densely populated and are being pushed towards expansion of infrastructure starting with the construction of multi-storey and multi-residential dwellings. These types of construction are possible due to the accessibility of cheap and convenient building materials such as concrete and steel. However, new building materials such as Cross Laminated Timber (CLT) are striving to enter the construction industry to reduce labour costs and provide a more renewable source of construction materials which offer a similar strength in terms of properties.

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Investigation of the Viability of Using Glass Primary Structural Members in a Low-rise Building - (12cp)
Maryo Faris - A15-021

Supervisor: Anne Gardner
Assessor: Ali Saleh
Major: Civil Engineering Major BE and BEdipEngPrac

Glass has been available commercially for many years, however it has not been a common material that structural engineers look to utilise to carry load in their designs. The main reason for this is that the properties of glass indicate that failure of such members would be brittle, which is in fact undesirable in engineering design. Architects and other members of society appreciate that glass has high aesthetic qualities for buildings and other structures due to its transparency and modern appeal. The notion of using glass as primary structural members and hence designing entire buildings made of glass would be extremely desirable to these stakeholders. This is assuming there are standards that provide a detailed design approach and specifications to meet relevant safety requirements. There are many factors that will affect whether this is viable such as type of glass, member sizing, construction processes, failure mechanisms and many more outlined in this report.

Aside from the engineering point of view, glass use in primary structural members requires acceptance of the general members of society in terms of safety. In addition, the costs of glass in comparison to the more traditional construction materials such as concrete, steel and even timber will need to be acknowledged for this to be viable. A model of a glass structure will be used to provide an indication of the viability of using glass based on literature review, Australian Standards and structural analysis. The analysis in this study shows that while it is possible to design and build a glass structure, the costs and architectural issues regarding floor space become a major issue. Glass was found to be a sound structural element however requires further experimental research to set out data and design standards. In the meantime glass should be used as a façade and secondary structural element until its structural properties are clearly standardised.
Container Capacity Assessment of the Port of Fremantle - (12cp)
Shane Freeman - A15-162

Supervisor: Ken Halstead
Assessor: Ali Saleh
Major: Civil Engineering Major BE and BEDipEngPrac

Australia being an island nation and geographically remote from major suppliers and markets, relies heavily on sea-borne trade. Container ports are the primary gateways for international trading and Australia is no different with several key facilities forming the backbone of the country’s economic infrastructure [Curry 2013].

The Port of Fremantle (the port) is the gateway for international trade to Western Australia and the fourth largest container port in Australia located at the Inner Harbour on the Swan River. The port is currently managed by the Fremantle Ports Authority, a Western Australian Government trading enterprise.

The port has recently gained significant interest from the private and public sector as a result of the Government plans to sell the port as a 49-year lease. A key issue of the sale is the capacity of the port, when a new container port will be needed and the capacity of the new container port.

This report forecasts the container trade and container vessel demands of the port over a 25 year period at 5 year increments from 2015. The forecasts are then used to assess the capacity of the approach channel to safely navigate the design vessel; the quayline to facilitate trade and the berthing of the design vessel; and the container terminals to support trade.

The outcome of the report respecting the container trade and container vessel forecast is the identification of the infrastructure constraints; a timeline of when infrastructure upgrades will be required; and an outline of the infrastructure that will be able to support the forecasts including:

- The capacity of the port in its existing state
- How the existing port can be reconfigured to defer the development of the new container port
- When the new container port will need to be available
An Investigation into the Design and Construction of Pavements in Sydney’s CBD - (12cp)
Daniel Fruci - A15-154

Supervisor: Ken Halstead
Assessor: Ali Saleh
Major: Civil Engineering Major BE and BEDipEngPrac

The correct design and construction of pavement layers is a task that Engineers can effectively coordinate so as to produce the most optimum, efficient and cost benefiting solution for specifically modelled cases e.g. highways right through to minor local access roads. It is essential that the Pavement Engineer’s role is fulfilled by designing a suitable layer formation that can be adequately constructed from good quality materials to sustain proposed traffic loading and any other excess loading requirements over a specified time period which will not result in varying modes of failure or significant maintenance re-work during the pavements design life.

Within the CBD, the two main stakeholders responsible for managing and coordinating the roads network are the ‘Roads and Maritime Services’ and the ‘City of Sydney Council’, both of which have detail varying approved pavement plans for works within their corresponding jurisdictions. As such, the purpose of this report serves to first analyse pavement design as a whole during the Literature Review chapter focusing on aspects such as foundation requirements, drainage, proposed materials, flexible and rigid pavement design and overall construction aspects. It will then classify which roads within the CBD each of the above stakeholders are responsible for managing and then conduct an evaluation into their proposed pavement cross-sections referencing specific extracts from their technical specifications. A comparison has been made to Literature findings so as to assess their suitability for CBD trafficking. The report will also compare pavement designs from both stakeholders against each other and form the basis of recommendations for improvement to be undertaken to City of Sydney Council design, complimented by way of sketches and tabulated feedback.

Two case studies are introduced to compliment the report by way of validity and provide industry consistency in conjunction with survey feedback received from practicing Pavement Engineers.
Wireless Multimeter and Data Monitoring System - (12cp)
Pouya Ghaheri Tabrizi - A15-240

Supervisor: Steven Su
Assessor: Quang Ha
Major: Electrical Engineering Major BE and BEDipEngPrac

Still to this day, various jobs within the Electrical Industry are perceived as "dangerous" as they involve working in environments that can expose workers to numerous risks. These risks include employees being subject to electrocution, radiation, heights and other environments with high risk of accidents.

Knowing about such dangers as well as my own father suffering major electric burns in 1968; which was whilst he was inspecting an induction furnace working as an electrical engineer. I decided to develop a system which eliminates entering dangerous environments in order to monitor data such as Voltage and Temperature.

This capstone project details the design and capability of a Wireless Multimeter and Data Monitoring System which is capable of reading crucial data such as Voltage and Temperature. The data is then transmitted and the information is displayed on an Android™ tablet or mobile phone. The wireless system which is embedded into this project is based on Bluetooth® technology which operates on 2.4GHz ISM band. The aim of this project is to develop a system which introduces safety, efficiency and accuracy to many working environments by allowing users to collect data from a safe and convenient location.

This project is also designed to be compatible with numerous data recording requirements making it suitable for many other industries. For example, this project can be used for the wildlife rescue where the users can monitor crucial data of dangerous animals without approaching them each time.

The major design and development of this project involves designing and building two major components being Measuring Unit (MU) which entails an electronic circuitry to measure data in both digital and analogue format and Displaying Unit (DU) which will display relevant data recorded by the Measuring Unit. Unlike the Measuring which is mainly based on hardware, the Displaying Unit is based on software where an Android™ application needs to be developed to operate in conjunction with the measuring unit where clear user interface and high security will be the basis of the application to be developed.
Steganographic Image Sharing App - (12cp)
Jake Gibbons - S15-018

Supervisor: Zenon Chaczko
Assessor: Min Xu
Major: ICT Engineering Major BE and BEDipEngPrac

With the advent of smartphones, many people have the ability to take a photo and upload it to the internet whenever they want. Most smartphones will include basic metadata in the image file; however, this is usually limited to information about the camera itself, and not the content of the photo. This data is also easy to access, as there are many websites and applications that will extract the metadata from an image, thus it is unsuitable for personal information.

While there are many applications out there which will allow a user to take and upload photos for their friends or the public to view, such as Facebook or Instagram, these applications rely on information provided alongside the image for privacy settings, commenting, and image searching. Other search engines would have difficulty categorising the pictures they find on various sites, and if the image is saved and re-uploaded somewhere else, the information about them would likely be lost.

Steganography provides a feasible and viable solution to these problems. By embedding information directly into the image, the information about the image will not be lost, if it is separated from its original source. The aim of the capstone is to demonstrate this aspect via an image sharing app that allows users to exchange messages and personalised information that is embedded in the image such that it is inaccessible without knowing their keys, and metadata that can be used by search engines to categorise the image and its contents. The developed application will provide a platform for users to create an account, share images, embed information within the image, and search for images other users have uploaded.
Testing the Extent to which a Product Complies with Standards (Upon metal ladders) - (12cp)
Mariette Girgis - A15-243

Supervisor: Bruce Moulton
Assessor: Peter Tawadros
Major: Mechanical and Mechatronic Engineering Major BE and BEDipEngPrac

Ensuring the presence of the safety factor in every product we use is a main concern for every researcher. That’s why many researches were done by experts throughout many years to put some critical regulations that should be taken into consideration while using portable metal ladders. This research specifies the differences between different metal ladders’ standards; such as the Australian, European and American standards. Also, it includes some testing procedures and their results upon a sample (Australian) product to ensure that it complies with the standard.

Some accurate comparisons were done between the standards as a first step and then practical tests took place. In order to conduct these tests, which depend on the Australian standard mainly, the presence of a lab was essential and all the required equipment to perform some of the mentioned tests in the standard. Accurate results are presented, showing the ability of the product to endure the standard’s conditions. Some important observations were noticed that show the product’s quality and whether it is safe or not to use.

This research is considered quite interesting and important at the same time, as it might prevent many hazards and injuries that might happen while using portable metal ladders and thus increasing the safety factor in general in any workplace or even in the domestic use. It was very useful to do this research as it is considered a good resource that present some important information about metal ladders that should be acknowledged by every ladder user.
Engineering Sulfated Glycopolymers for Tissue Regeneration - (12cp)
Xue Gong - A13-001

Supervisor: Simon Ting
Assessor: Steve Ling
Major: Mechanical and Mechatronic Engineering Major BEBBus and BEBSc

The extracellular matrix is a dynamic network that determines how the tissue looks and functions. It provides structural support for tissues and regulates cell proliferation and differentiation. It also acts as a storage for proteins such as growth factors and cytokines that works together to modulate bone remodeling.

The extracellular matrix (ECM) is made up of structured proteins. These include collagen and elastin that provide stiffness and elasticity to the connective tissues and sulphated proteoglycans. Aging reduces the efficiency of chondrocytes in renewing the matrix which leads to the shrinkage of proteoglycans and chondroitin sulphated chains. This is the major cause of osteoarthritis. Synthesising sulphated glycopolymers that act as mimetic of chondroitin sulphated glycosaminoglycans (GAG) may aid in re-establishing the cartilage layer of the bone. Previous studies have also shown that interaction of sulphated glycopolymers to protein receptors are significantly higher than the non-sulphated glycopolymer, thus sulfation also plays a major role in growth factor protection and osteogenesis.

In this project, Reversible Addition Fragmentation Chain Transfer (RAFT) polymerization is employed to engineer sulphated glycopolymers as mimetic of the chondroitin sulphated GAG for ECM tissue regeneration of the bone and cartilage. 3-D-Galactose pentaacetate and mannose is used to synthesise the glycomonomer for RAFT polymerisation with the RAFT agent cumyl phenyldithioacetate (CPDT) and initiator 4, 4’-Azobis 4-cyanovaleric acid (ACVA). Deacetylation of the glycopolymer is achieved through the reaction with sodium methoxide. The resulting de-protected glycopolymer is sulphated using sulfur trioxide trimethylamine (SO3-NMe3). Fourier transform infrared spectroscopy (FTIR) is used to measure the stretch of the oxy-sulfate group and the hydroxyl group both before sulfation and after sulfation. Nuclear magnetic resonance (NMR) is used to monitor the reaction through analysis of the chemical shifts and zeta potential is used to measure the stability of the resulting polymer.
Electrocution was believed to be the biggest hazard and cause of death in the electrical industry up until the late 1900’s when an increased awareness and understanding of the behavior of electrical accidents outlined the pertinence of arc flash events in electrical installations.

The Institute of Electrical and Electronics Engineers (IEEE) and the National Fire Protection Association (NFPA), report that in the USA alone, an average of 2000 electrical workers are admitted for burn injury treatment throughout the year, with an estimated 80 percent stemming from arc flash events. The extent of injuries and damage has proven arc flashes to be the biggest cause of accidents and destruction within electrical systems. Although the electrical sector is largely considered safe due to the small percentage of reported accidents within industry, the potential for damage is disproportionally large.

Electric arc flashes and associated arcing faults can result in explosions which are triggered from the rapid release of energy due to an arcing fault between two phase-busbars, a phase-busbar and a neutral line, or a phase-busbar to ground, where the current passage is the vapour of the arc terminal material.

Two main standards have arisen as the only available guides in this field, IEEE 1584 and NFPA 70E; both of which were developed to address US regulations to mitigate and prevent the effects of potential explosions by quantifying potential hazard levels. Neither standard is appropriate in an Australian context due to an array of inconsistencies with existing local regulations (AS/NZS); however, in the absence of a local equivalent, these standards have become the accepted arc flash guides within industry.

This project aims to assess the arc flash hazard from an Australian naval-marine perspective where larger power distribution systems are regularly facing an increasing demand for greater capability at sea, increased fault current levels, and the potential for arc flash accidents. Whilst arc flash hazards are being investigated in land-based industries, little is known about the applicability of these standards to the marine sector. As such, the aim of this project is to investigate the deficiencies that exist in applying the land-based standards and recommendations to a naval platform.
Design of Multistory Building with Comparison of Reinforced Concrete and Cross Laminated Timber - (12ep)
Mootassem Hassoun - A15-041

Supervisor: Rijun Shrestha
Assessor: Yancheng Li
Major: Civil Engineering Major BE and BEDipEngPrac

Due to expanding world population: cities have become more densely populated and are being pushed towards expansion of infrastructure starting with the construction of multi-storey and multi-residential dwellings. These types of construction are possible due to the accessibility of cheap and convenient building materials such as concrete and steel. However, new building materials such as Cross Laminated Timber (CLT) are striving to enter the construction industry to reduce labour costs and provide a more renewable source of construction materials which offer a similar strength in terms of properties.

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Analysis and Review of Ultrasonic Cleaning Machine - (12cp)
Pei-Chen Ho - A15-256

Supervisor: Youguang Guo
Assessor: Steven Su
Major: Electrical Engineering Major BE and BEDipEngPrac

Ultrasonic technology has been widely used in the cleaning industry. A generator is responsible for generating high-frequency energy which passes through a transducer; this is the basic principle of ultrasonic technology. In terms of energy conversion, electrical energy is converted to mechanical vibratory energy. Once the transducers are in contact with a water-tank, cavitation occurs within the liquid due to the present vibration. The cavitation energy is responsible for removing the stains on the surface while leaving the finished product undamaged.

This project contains a literature review of principles of ultrasound, a comparison of different series of common cleaning methods; it also includes a review of the advantages of ultrasonic cleaning systems. In addition, a selection guide of suitable generator, transducer and tank is carried out. Moreover, this project involves building a prototype of an ultrasonic cleaner in order to understand the physical and electrical principles governing the equipment.

Prior to the prototype assembly procedure, the details of the generator, the transducers and the tank were determined according to the selection guide. During prototype assembly, the generator was calibrated and the transducers were mounted to the bottom on the tank. In order to test the performance of the ultrasonic cleaner, a foil performance test has been carried out, which involves inserting an aluminium foil in the tank to study cavitation impact. From the findings of this project, the project also discusses the future possibilities with regards to ultrasonic technology, how efficiently it can be optimised for better performance and recommendations for further studies.
Design and Fabrication of a Medium Platform Folding Quadcopter for use in Aerial Imaging Applications - (12cp)
Brendon Hol - A15-081

Supervisor: Dongbin Wei
Assessor: JC Ji
Major: Mechanical Engineering Major BE and BEDipEngPrac

This project focuses on the design and manufacture of a frame for a medium platform folding quadcopter also known as a ‘drone’. The quadcopter will be used for aerial imaging tasks such as video and photography. The purpose is to design a quadcopter that will be highly portable, while still being able to carry a gimbal, as current commercial quadcopters are bulky, most notably when being transported.

The design delivers a solution that is more compact than currently available when transported while still offering similar levels of functionality when operational. This makes transportation easier for operators allowing them greater flexibility in the field.

The main objective is to design a quadcopter that occupies substantially less volume than that of the market leader at the commencement of this project, the DJI Phantom 2. While achieving this critical goal it also needs to be competitive in other performance aspects such as weight and flight time. The quadcopter is required to produce smooth, vibration free footage from the on board camera.

To achieve this goal modern manufacturing techniques such as CNC milling and 3D printing enabled fast prototyping. To achieve a compact design the quadcopter uses vertically opposed propellers which allow for a small fuselage section for compactness when being transported. When operational is folds out allowing it to accommodate a large propeller diameter. In order to reduce vertical height of the quadcopter a 2D gimbal was mounted on the front rather than a conventional gimbal which hangs beneath.

A prototype of the design has been manufactured and currently undergoing testing. So far the quadcopter meets most of the design objectives however there is still work being done to improve smoothness of flight footage. Once all issues with the prototype have been noted a second prototype will be produced to rectify these issues.
Design and Evaluation of Direct Metal Laser Sintered Alloy Automotive Components for Light weighting - (12cp)
Atlas Huang - A15-173

Supervisor: Terry Brown
Assessor: JC Ji
Major: Mechanical Engineering Major BE and BEDipEngPrac

Direct Metal Laser Sintering (DMLS) and Topology Optimisation technologies are assessed for weight reduction on automotive components. Weight reduction has always been one of the key factors to increase vehicle performance. Topology Optimisation has the potential to assist designers to create the lightest possible design for an automotive component and DMLS technology can produce complex geometry in metal, together they are powerful tools for weight reduction and vehicle lightweighting that doesn’t waste materials.

This study focused on the methodology for using topology optimisation with DMLS part production and the subsequent physical testing of DMLS component for comparison with computer simulation results.

Ansys Mechanical finite element analysis (FEA) software and Genesis Topology for Ansys Mechanical (GTAM) topological optimisation software were used in this study. GTAM uses the FEA result from Ansys to produce the optimised geometry. Multiple load case studies were included to ensure the design is optimised for real life application.

Ti-6Al-4V (Ti64) was selected as the testing material due to its high strength to weight ratio and as there is little published research on Ti64 DMLS produced structural components.

An aluminium rocker (an automotive suspension structural component) from a Formula SAE car was investigated as a case study. An optimized part with significant weight reduction in comparison to the original rocker assembly was produced. Furthermore, the original 3 part rocker assembly (2 side plates and rocker barrel) was reduced to a single part which can reduce overall fabrication and assembly time. Guidelines for starting geometry, boundary conditions (load and constraints), mesh size, etc. based on the case study example were developed. Critical functional/assembly features/regions, such as the original rocker bearing housings are specified to ensure the fitting of the optimised model. Build direction and the requirement for support material in the DMLS process are also important design inputs on the topological optimization.
Development of SCADA System - (12cp)
Rui Jiang - A15-184

Supervisor: Steven Su
Assessor: Shoudong Huang
Major: Electrical Engineering Major BE and BEDipEngPrac

This project is a further development of the subject project for the subject Data Acquisition and Distribution (DADS). Specifically, in this project, we develop a Supervisory Control and Data Acquisition system (SCADA) to remotely control the temperature control system developed in DADS Project. SCADA system is an automation control system which can be used to monitoring and control operational equipment during producing process and dispatch base on the computer.

In this project, our group use data collection devices, Adam modules, to control the temperature kit (embedded with fan, heater, and sensor) and Schneider Citect SCADA (http://www.citect.schneider-electric.com/scada/citectscada) to building an interface to monitoring and control the system. There are four Adam models used in this project; different model use different equipment to support the system. For example, Adam 6017 needs two extra power supplies, Adam 6022 needs two relay to separate the loops and Adam 6050 needs work with Adam 6015 and RTD sensor to control the kit.

Each model has two outputs (one for fan and another for heater) and one input for sensor. Adam modules connect between PC and kit, and PC is used to receive data and actuate the device. The interface includes temperature reading, auto switch, fan and heater’s switches and operating lights, target temperature input, and temperature trend graph. Also the data can be saved by the interface.

The developed supervisory control system provides the real time switching control for the regulation of the temperature of the kit. Desired control performance has been achieved. For the test result of Adam 6022, the steady state error is within 0.7 degree and system overshoot is less than 1.2 degree with desired response time.
Low Yield, Ground Water Pumping - (12cp)
Chanelle Julien - A15-108

Supervisor: John Dartnall
Assessor: Guang Hong
Major: Mechanical and Mechatronic Engineering Major BEBBus

Throughout the developing world, there is a well-established and critical need for access to clean drinking water. With much of available surface water contaminated and allowing for the rampant spread of dysentery and other diarrhoeal diseases, methods of accessing clean water and eliminating contamination is imperative.

The United Nations (UN) initiative of the Millennium Development Goals (MDGs), specifically Goal 7, Target 7c, has seen a globally improved access to water, with areas such as Eastern, Southern and South Eastern Asia, as well as Latin America and the Caribbean meeting their targets earlier than anticipated. However, the World Health Organisation’s “Drinking Water and Sanitation 2014 Update” has reported that certain areas including parts of the Caucasus, Central Asia and Sub-Saharan Africa have experienced a decline in available drinking water. At this time, approximately 748 million people do not have sources of improved drinking water.

Despite these efforts, the mortality rate of approximately 2,000 children a day (those under five years of age) has been attributed to purely diarrheal diseases, remaining relatively constant since the 1980s (WHO, 2014). Reports have also shown that the installation of a hand pump in rural communities only reduces the incidence of disease up to 25% (UNICEF/WHO, 2009; Pande et al., 2008; Halvorson, 2004).

This paper is split into two parts. Through a comprehensive literature review examining contributing socio-economic and cultural issues, the first aims to analyse the underlying factors contributing toward the low reduction rate of disease. Exploration into renewable energy technologies as well as a piped-access feasibility study have been used in formulating the recommendations to help bypass these issues.

The second part of this paper details a guide to manufacturing a hand pump which will become a project for future engineering students undertaking the subject 48261 Manufacturing.

Essentially what this paper provides is a study into innovating and optimising away from the VLOM hand pump configuration toward a sustainable, piped-access to home configuration in rural areas.
Application of Risk Management Techniques in Civil Engineering Organisational Processes - (12cp)
Bahjat-Jamil Kilzi - S15-023

Supervisor: David Eager
Assessor: Ravindra Bagia
Major: Civil Engineering Major BE and BEDipEngPrac

A concept which has gained increased momentum and consideration within civil engineering and construction organisations is the adoption of risk management. The increased trend of engaging in change to meet and exceed the triple bottom line of social, environmental and financial aspects has resulted in increased pressure for such organisations to identify and assess the risks accompanying these changes. Projects undertaken within the construction sector are complex, exposing the organisations to significant budget, time and quality constraints. As a result, civil engineering and construction organisations are directing their attention towards developing and improving risk management procedures and techniques. Risk management has aided these organisations to identify and forecast which risks have a higher likelihood of inducing a positive return. Without this, possible instability and project failure may be experienced.

This research project constitutes a synthesis of civil engineering and construction organisation risks and risk management applications; presented through the completion of a theoretical review, analysis and discussion specific to the construction sector. In order to examine these risks and risk management applications industry interviews have been conducted to bridge the gap and align the concepts discussed within the theoretical frameworks with actual practice.

The study endeavors to add value to the readers understanding of construction sector risk management, exploring six organisations, three which succeeded with their change management approach and three which failed. It results in identifying that the utilisation of risk management techniques are vital in controlling change to minimise losses but increase profitability. Furthermore, the interviews identified that the notion of risk management within the construction industry is heavily reliant on experience, judgement and intuition highlighting that the application of risk management techniques are implemented by all interviewed organisations but to a varying extent and formality.

The study is imperative in increasing the reader’s knowledge on the construction sector’s perspective on risks, what risks these organisations are confronted with, how they manage and mitigate these risks and what could have been done to further prevent and minimise the risks occurrence on future projects. The findings are presented drawing recommendations for the organisations and further studies in the area.
Development of a Novel Open Source 3D Printer - (12cp)
David Ledger - S14-136

Supervisor: Peter McLean
Assessor: Ben Rodanski
Major: Electrical Engineering Major BE and BEDipEngPrac

Open source 3D printers have evolved substantially in capability over the last 8 years. They give individuals the ability to prototype quickly and cheaply, something that historically has been a major barrier for many inventors and entrepreneurs. There is a trend towards decentralized production, which gives individuals the ability to produce products as needed, when needed. 3D printers are a driver of this trend, because they reduce the capability gap between large corporations, small businesses, entrepreneurs and individuals.

The development of the open source 3D printer required electronics design, a controller board with five motor drivers, numerous precision analog current loops, USB and SD card interfaces, high current switches and a WiFi board. The mechanical system design is novel, in order to showcase new topologies. The software is designed, in highly modular fashion. The software modularity is intended to ensure that the system could be quickly and easily be repurposed to a variety of applications from CNC machining to robotics.

This project makes a major step forward in open source 3D printer design and further stimulates the movement. It sets a higher standard for future designs through improved and freely available electronics, mechanical and software designs.
Experimental Modelling of VAWT on Building 11 to Enhance Performance - (12cp)
Eric Lee - A15-090

Supervisor: Jafar Madadnia
Assessor: David Eager
Major: Mechanical Engineering Major BE and BEDipEngPrac

With the advent of renewable energy sources to face global warming, big city pollution and increased energy consumption around the world, wind turbines have become more sought after to assist in power generation in place of more conventional power generation like coal and natural gas. These systems are commonly seen around giant wind farms taking up large amounts of land and are owned by energy companies to provide green energy; smaller more ingenious systems are also being employed to high city structures to decrease energy costs.

The objective of this capstone project is to investigate and optimize vertical axis wind turbine systems (VAWT). This project will focus on developing a more efficient and effective VAWT system which can greatly enhance the longevity of the system and expanding the window of operation to suit conditions in urban environments.

Even with currently operational VAWT systems such as the one installed on top of building 11, it is possible for its efficiency to be optimized by adjusting the shape of each individual aerofoil and its respective angle of attack. A model wind turbine is used in this project where the blades are powered by a motor on a cross flow counter rotating fan setup, the most efficient setup is based on the measurements achieved by a combination of variables which include but not limited to RPM and electric power (W) used, number of blades and blade angles.

This investigation focuses on a wind turbine that is designed and utilised in an urban environment, this can serve as a stepping stone to ease in recognition and acceptance of a new generation of renewable energy systems implemented into urban environments.
A Generic Risk Assessment for Health Infrastructure Projects - (12cp)
Matina Lianos - S15-014

Supervisor: David Eager
Assessor: Ravindra Bagia
Major: Innovation Engineering Major BE and BEDipEngPrac

Current risk management standards and guidelines do not provide recommendations as to what the most appropriate risk assessment technique is for each phase of a project’s life cycle. Identification of risk throughout a project’s duration is critical in order to anticipate and mitigate problems.

This report details the creation of a generic risk assessment for health infrastructure projects derived to illustrate the importance of project life cycle phases risk assessment guidelines. The generic risk assessment required the establishment and analysis of the life cycles phases of both the project and associated products life cycle. Once the scope of each phase of the product and project life cycle was defined, the need for specific risk analysis criterion at each phase was identified. Recommendations were made drawing from the Australian Standards on risk assessment to determine the most applicable qualitative risk analysis tools. Each tool is used to address the risk analysis needs for that specific project phase.

Using the established scope for the product and project phase using and the associated recommended techniques a risk analysis was completed. The outputs from the analysis were converted into a risk register and reviewed by individuals who have extensive experience with construction of health infrastructure. The output produced results which accurately identified realistic and diverse risks required for health infrastructure projects.

The greater application of this investigation is to promote cross project learning within an organisation which undertakes a number of health infrastructure projects. The results and recommendations are to act as a guide for organisations to develop organisation specific risk registers. This risk register can then be circulated and developed further as requirements change and grow with new health infrastructure projects.
Grid Connected PV Generation with Optimal Storage for Energy Shifting (12cp)
Kun Chih Lin - S14-044

Supervisor: Peter Watterson
Assessor: Jianguo Zhu
Major: Electrical Engineering Major BE and BEDipEngPrac

A grid-connected PV system with optimal storage for the purpose of energy shifting has been designed in this capstone. It surveys the renewable energy landscape outlining a brief history to demonstrate the susceptibility of renewable energy to the politics of the day. It is shown that the correlation between technology, development and politics underpins the uptake of these renewable energy technologies coupled with the decreasing cost of systems over time.

A case study of this system as applied to a typical (small) residence in Sydney is undertaken. The load profile for the functional simulation is obtained by power logging the premises over 5 consecutive days whilst insolation data is obtained from the UTS FEIT renewable energy rooftop weather station. Since the resident consumes 71% of his daily energy requirement between 7am – 8pm, of which 6 hours is in the peak tariff period, there is an interest to offset this. Thus an optimally sized battery for storing the energy produced during the day for dispatch during peak tariff periods should enable a benefit equivalent to $0.50611/kWh Inc. GST.

The aim is to show how such a system could meet energy needs whilst offsetting the cost of electricity during high tariff periods. The central theories are introduced including the development of models which is then integrated into a complete system. Using average feed-in tariff rates, the simulation shows the daily savings delivered by a 2kW PV array and 2.4kWh battery would range from $1.17 to $1.48 and average $1.41 over the days logged. The system would deliver estimated average daily saving of approximately $1.50. Used conservatively, the battery contribution is valued up to $0.30 daily depending on insolation and generates savings equal to the feed-in tariff value of a much larger PV array.
Comparison and Verification of Recorded Strain Gauges for Different Types of Concrete - (12cp)
Mao Liu - A15-201

Supervisor: Shami Nejadi
Assessor: Anne Gardner
Major: Civil Engineering Major BE and BEDipEngPrac

From single units to massive high rises, concrete has been a fundamental material component which is being selected for civil engineering applications. It can be clearly observed that concrete has played a critical role in the construction industry and this has led many to study its structural behaviour and strengths under serviceability. There are many strategies and techniques that are feasible to interpret how concrete functions with respect to time and load. As far as strain is concerned, factors that may distinguish and affect the ideal results would sometimes be significant.

The predominant scope of this project is to perform calculations obtained from the experimental results of six different types of concrete and further compare these values with a finite element based software's output. Ultimately, the higher performance type of concrete can then be determined after comparing results from this study.

The project mainly concentrates on the different mechanical properties of concrete with respect to 14 days and 28 days curing time. A total of 14 slabs with strain gauges embedded in them had been tested and verified. Apart from the different types of concrete being used (N-SCC, D-SCC, S-SCC, DS-SCC, LWC and NC), all slabs have been casted identically. This includes matching cement to water ratios, environment, curing durations, and geometrical dimensions. Each concrete slab consists of 4 tensile reinforcement bars (4N12) at bottom, thus making it a one way slab classification. For the purpose of monitoring the strains, strain gauges embedded in concrete to observe its long-term performance. Finally, factors that may affect the long-term behaviour of the six different types of concrete will be discussed and design oriented suggestions will be made.
Structural Health Monitoring (SHM) of Sydney Harbor Bridge’ - (12cp)
Yue Liu - A15-000

Supervisor: Ulrike Dackermann
Assessor: Jianchun Li
Major: Civil Engineering Major BE and BEDipEngPrac

Structural Health Monitoring (SHM) is any automated monitoring practice that seeks to assess the condition or health of a structure. The aims of SHM are that devote to monitor a structure with any introduced damage, or any growth of inherent faults, would be immediately detectable. Due to the reasons from the design, construction, loads or materials, there exist inevitably some macroscopically injuries and defects in concrete structures in the process of building and use. Theses injuries and defects must affect the safety and durability of structures disastrously. Currently, a new concept of ultrasonic computerized tomography for concrete is developing, might reflect the inner defects of concrete by images in tomography. That is to be inevitable development tendency in ultrasonic test for concrete from non-destructive test to non-destructive diagnosis. At present, the theoretical research in this field is still on its early stage.

Under the academic exchange between University of Technology, Sydney and BAM Federal Institute for Materials Research and Testing, BAM introduced a new technique on ultrasonic computerized tomography for concrete in the project related on Structural Health Monitoring (SHM) of Sydney Harbour Bridge. In the project, Simultaneous Iterative Reconstruction Technique (SIRT), was introduced as a particular technique to perform tomographic reconstructions of the acoustic velocity profile of the concrete specimen. It uses a model at the beginning which will be repeatedly adapted through the process, that way the non linear inversion problem can be solved.

In this paper, ultrasonic computerized tomography technique is presented, including its methodology, SIRT algorithm, experimental research. In the experiment, a concrete specimen will be introduced in the experiment, which replicates the geometry and material properties of single arch joint from the Lane 7 on Sydney Harbour Bridge. Based on experimental measurements of the velocity v of acoustic waves propagating through the concrete specimen, seem to be very suitable for evaluating the health condition because they give information immediately, rapidly and relatively low cost.
Steam Turbine Ultrasonic Testing – In-Situ Rotor Disc Dovetail Inspection (12cp)
Vincenzo Mammoliti - A15-150

Supervisor: Guang Hong
Assessor: John Dartnall
Major: Mechanical and Mechatronic Engineering

Steam turbines are an imperative component for power generation, converting thermal energy from highly pressurised steam into mechanical work in the form of rotation. The attachments of the blades to the rotor disc are necessary inspection areas to ensure no cracks or flaws are developing which could lead to critical failure. Ultrasonic testing with conventional and phased array techniques have been widely used in the industry to inspect tangential-entry dovetail attachments without needing to remove the blades.

Current methods employed by Toshiba International Corporation (TIC) require the turbine rotor to be removed from its casing and placed on rotor stands in order to perform an ultrasonic inspection on the dovetail attachments using an existing jig. An investigation has been performed to assess the current inspection system and the possibility of conducting this inspection with the turbine in-situ. By performing the ultrasonic inspection in-situ, a significant saving on required resources including time, labour and workshop space is expected to be made since the rotor does not have to be removed and reinstalled into the casing, also offering the opportunity for TIC to provide this inspection service where it was otherwise impractical.

The fundamental principles of ultrasonic testing were first explored before reviewing inspection techniques used to perform a typical dovetail ultrasonic inspection. An in depth analysis of the inspection equipment used throughout the industry formed the basis of ideas that could be combined to accommodate an in-situ inspection. The suitability of the equipment and processes used by TIC were evaluated, with proposed designs or modifications to the existing system provided where considered appropriate, aiming to accommodate an in-situ inspection and improve the overall inspection technique.
Geotechnical investigation is essential in providing adequate foundations. This means the soil in which roads and buildings are built on require adequate strength to enable load transmission from foundations to soils while maintaining serviceability. Most soils have enough characteristics for such load transmission to occur without any effort of stabilisation. However, soils problematic in nature such as highly reactive clay tend to have low bearing capacity and have large or unpredictable settlements.

Moreover, expansive soils under loading in unsaturated conditions exposed to moisture increases result in losing their suction; and hence the negative pore water pressure diminishes. Whereas, the decrease in moisture will result in suction of expansive soils. Hence, providing treatment of clayey soils for stabilisation is necessary for their use in development of roads and buildings.

Treatment of soils typically occur by replacements of chemical additives or organic and inorganic additive materials. The waste by-product bagasse fibre of the agricultural industry may be suitable for stabilising expansive soils. Disposal of such sugarcane waste contributes to increases of landfill in Australia. As such, applications of bagasse fibre ideally are intended to improve expansive soil properties and provide more stabilised soil. Current methods of stabilising soil in roads, buildings, and bridges require piles, which can cost more. Stabilising soil with bagasse fibre is a less expensive approach. Furthermore, the use of bagasse fibre can hinder the impact of environment pollution caused by the disposal of bagasse.

This study aims to provide an experimental method to quantify the use of bagasse in expansive soils. Laboratory experiments were conducted on black soil collected from Queensland coastal regions with partial replacement by bagasse fibre (0.5%, 1.0% and 1.5%) without any chemical or cementitious material. The study additionally highlights the effects in properties of black soil from treatment with bagasse fibre.
3D Person Tracking in Dense Environments - (12cp)
Jay Mehta - S15-028

Supervisor: Alen Alempijevic
Assessor: Teresa Vidal Calleja
Major: Mechanical and Mechatronic Engineering Major BE and BEDipEngPrac

There is a growing desire to improve customer safety and experience in public transportation systems. In order to gauge the interaction of passengers and infrastructure it is necessary to ascertain information on passenger motions in and around the train stations, observing their interaction with other passengers, fixed infrastructure as well as rolling stock.. There has been an increasing amount of research and advances in person tracking in real-time and dense environments. However, there are several challenges with tracking, especially in dynamically adapting the tracking methods to a large number of passenger interactions. Current methods are only able to address these issues in some cases, for instance, multiple camera based methods may be sensitive to background clutter.

This project aims to improve real time person tracking in dense environments by detecting the interaction events and extracting information on the number of people as well as their position during the interaction. To maintain a track, it is important to have information relating to that person, however, quite often a person can get occluded for a significant amount of time from the sensor viewpoint during passenger interactions. This project explores different methods to accurately identify these events using 3-dimensional depth data from RGBD sensors.

This project improves on the existing method with a clustering approach of individual persons during interactions. The proposed method is able to remove sensor noise which improves the accuracy of segmenting point cloud data. It should also significantly improve the detection rate of legible persons during merge events and it is thus expected to improve person tracking in general.
Applications of 3D Camera’s for Smart Classrooms – (12cp)
Ara Melkonian

Supervisor: Zenon Chaczko
Assessor: Min Xu
Major: Software Engineering

Classrooms have adapted to include technology to assist in teaching, while interacting with these devices have not advanced, as they still use traditional peripheral devices (keyboard and mouse) to interact with the applications. These inputs restrict learning within the classroom environment as only one user may interact with the application at any one time. By using the Soft-Kinetic Depth Sense camera it becomes possible to interface with these applications using natural hand gestures, allowing the classroom to become an active environment, whereby any user can control the device.

The aim of this project is to provide an accompanying method of input for smart classrooms applications and to create a natural gesture dictionary which contains information regarding the representation of each gesture ranging from pointing, swiping and pinching. The application will be implemented using the Soft-Kinetic Middleware and Soft-Kinetic Close Interactions Library (CILIB).
Investigation into Role of Pavement Materials in Mitigation of Construction Defects and Cracking in Concrete Pavements - (12cp)
Daniel Mezger - A15-145

Supervisor: Kirk Vessalas
Assessor: Vute Sirivivatnanon
Major: Civil Engineering Major BE and BEDipEngPrac

Vital to the performance of an engineered product is a correlation between proper design, sound construction techniques and the correct selection of construction materials. During construction practices, concrete pavement layers at times do not achieve the necessary density requirements meaning that re-work is required. In addition, finished pavements often experience some form of cracking meaning that repair or complete replacement is required. The main drawbacks of these shortcomings is the additional cost, time and labour associated with maintenance, as well as the inconvenience caused by road closures. It is, therefore, necessary for concrete pavements to be constructed properly in order to mitigate the occurrence of construction defects and cracking in the finished pavement, thus, reducing maintenance requirements.

In this research study, the parameters of design, construction and materials selection were all investigated to determine their effect on the performance of concrete pavements. Pavement failures often originate beneath the surface. A major finding of this study was that the presence of expansive soils in the subgrade was detrimental to the performance of the subgrade with over US$1 billion spent annually on maintenance. This is due to the shrinkage-swelling capacity of expansive soils, which decreases the volume stability and exposes the pavement to the external environment. However, subgrades treated with lime were found to have increased strength and less defects such as rutting. Another important finding was that the top concrete layer was found to be highly susceptible to cracking. This is due to insufficient concrete consolidation, which not only lowers compressive strength, but also results in cracking due to the concrete hardening in a segregated state when it is not properly bonded. By taking a holistic approach to constructing concrete pavements via evaluating aspects of design, construction and material selection, a deeper understanding and insight into factors contributing to the occurrence of construction defects and cracking in finished pavements was achieved.
Evaluation of Hydration Behaviour of Fly Ash-Based Cement Pastes and their
contribution to Occurrence of Delayed Ettringite Formation - (12cp)
Surajbhai Mistry - A15-143

Supervisor:  Kirk Vessalas
Assessor:  Paul Thomas
Major:  Civil Engineering Major BE and BEDipEngPrac

The use of precast concrete elements has become an essential part of modern day civil engineering
construction. In Australia, precast elements are used in a variety of concrete structures including
bridge girders in bridge structures. Bridge girders are considered a key structural element
requiring both long service life and minimal maintenance. However, recent construction projects
have found that some bridge girders have been susceptible to deterioration and failure by means
of delayed ettringite formation (DEF). While DEF has been thoroughly researched overseas,
limited in-depth research has been carried out within the context of the Australian concrete
industry. This has led to construction specifications being forced to uphold imposing limits with
regards to the use of certain cementitious binders in concrete mix designs and the curing
temperatures employed to manufacture precast elements. This is all due to a lack of research and
available data for locally sourced materials and the consideration of local manufacturing methods
and curing conditions.

This study investigates the phenomenon of DEF in cementitious pastes using locally sourced
materials through the consideration of isothermal calorimetry and early age hydration behaviour.
Changes to the cementitious mixes including adjusting fly ash content and water-to-binder ratio
alongside increasing curing temperature were found to contribute to changes in the hydration
behaviour. The results demonstrated that while increasing curing temperature accelerated the
hydration process, increasing the fly ash content and water-to-binder ratio both delayed the rate
of hydration. In terms of ettringite formation, increasing the curing temperature resulted in greater
amounts of unhydrated early age ettringite remaining in the system. This means that there is a
higher possibility that ettringite can re-precipitate in the system as DEF at a later age. In contrast,
increasing the amount of aluminate by increasing the fly ash content in the binder allowed more
early age ettringite to decompose into the monosulfate phase. This would decrease the possibility
of DEF re-precipitating in the system at a later age.
Dynamic Rugby Union Scrummage Training Machine – Mechanical Framework Design - (12cp)
Dylan Mountjoy - A15-093

Supervisor: David Eager  
Assessor: Chris Chapman  
Major: Mechanical and Mechatronic Engineering Major BEBBus and BEBSc

The art of scrummaging is a complex but important part of the modern game of rugby union, providing teams with opportunities to initiate and execute set pieces or interrupt the offensive position of their opponents. For this reason, perfecting the art of scrummaging through practice and training is crucial for any teams who aspire to achieve consistently positive results regardless of participation level. It is within this training environment that an opportunity to engineer a solution which allows players to optimise their scrummage training presents itself.

Current scrummage training methods and equipment can only prepare a team for the basic aspects of a live scrum. This project aims to develop a dynamic rugby union scrummage training machine that can simulate as many aspects of a real scrum as possible using available technologies. The insight of coaches and players alike are key in assuring that the final product aligns with what they experience in live scrum situations.

To achieve this solution, research and understanding of both static and dynamic training equipment currently available has been conducted. A thorough understanding of the rules and regulations surrounding scrummaging outlined by the regulatory body World Rugby needed to be achieved. Consideration of scrummage techniques and the dynamics of a real scrum situation were some of the most important aspects that were defined through research.

This Capstone provides a primary study into the forces that the proposed dynamic rugby union scrummage training machine would experience on the mechanical framework. Various basic mechanical framework have been designed and using the data found through research, FEA studies were conducted on these various mechanical frameworks. Recommendations on the most appropriate mechanical framework are presented including material selection and sizing, with an emphasis on future works that can continue on for this project.
A Comprehensive Study into the Relative Importance of Concreting Materials and Concreting Practices on a Range of Concrete Properties -12cp

Tony Moussa - A15-156

Supervisor: Vute Sirivivatnanon
Assessor: Rasiah Sri Ravindrarajah
Major: Civil Engineering

Concrete has become an integral part of our lives and has allowed us to revolutionize the way we build. It has facilitated our endeavor for innovation, creativity and civil enhancement allowing us to materialize engineering feats of monumental value. However, all that concrete has demonstrated; the need for properties including autogenous and drying shrinkage, creep, chloride and fire resistance to be controlled and/or enhanced is still a developing area of interest. Assessment of the composition of concrete including; binder systems, type of aggregate and fibers, as well as concreting practices, such as curing and compaction allows the engineers to gain an understanding of the factors influencing the properties mentioned.

This will be achieved in two ways namely, a comprehensive literature review and statistical analysis of factors influencing available concrete properties data. The study aims to collate scholarly literature in order to recapitulate the factors influencing the various properties mentioned. While the factorial analysis examines published data in order to substantiate the relative importance of factors influencing drying shrinkage, creep, elastic modulus, sorptivity and resistance to chloride diffusion of concrete. These factors include the slag content in the binder, the type of aggregate and curing regimes.

The results show that for drying shrinkage, the main effects accounted for 93.6% of the total effects, of this, curing was seen to be the most influential, making up 90% of the main effects. For creep, the main effects accounted for 87.8%, of this aggregate was seen to have the largest influence (63.6%), followed by curing (22.4%) and binder (13.9%). For sorptivity, the main effects accounted for only 38% of the total effects, which consisted of binder (50.6%), curing (47.5) and aggregate (1.9%). The interaction effects were seen to be more significant than the main effects and accounted for 58% of the total effects on sorptivity, this consisted of binder & curing (97.2%) and aggregate & curing (2.7%). For the elastic modulus, the main effects accounted for 93.6% of the total effects, of this aggregate was seen to have the largest effect (65%), followed by curing (33.6%) and binder (1.6). For diffusion, binder was seen to have the largest influence followed by curing.
New Generation Hybrid Electric Vehicles in Modern Day Society - (12cp)
Abdullah Muqbali - S15-193

Supervisor: Huu Hao Ngo
Assessor: Wenshan Guo
Major: Mechanical and Mechatronic Engineering Major BE and BEDipEngPrac

Over the years the evolution of cars have been a great concern. Cars have been making our life easier, and not only has it been making it easier it has made more efficient and mostly, less time consuming. These vehicles, however do have their disadvantages towards the environment. To tackle the situation, professionals have developed Hybrid Electric Vehicles to reduce these effects in the Environment. Invention of Hybrid Electric Vehicles came as a solution to one of the greatest environmental problems; air pollution on one side, and a solution to fuel prices on the other.

In the last few years, pollution has considerably increased and the main reason behind the increased pollution is rise of vehicle emissions. This can easily be controlled and reduced substantially by replacing the conventional vehicles with hybrid vehicles.

An increased fuel cost and pollution level have forced people to think of newer techniques which can provide a viable alternative for conventional power vehicles. Techniques for developing hybrid vehicles which include buses, cranes, trucks and cars are gaining great popularity among different governments, people and businesses because of the high concern towards plummeting pollution to safe levels.

Hybrid vehicles are of many different types and they give numerous benefits for the user as well as the environment. New generation vehicles are designed to be environment efficient as well as can provide better performance and fuel economy.
Synthesis of Nanoreactors for Free Radical Polymerization - (12cp)
Andrew Ngadisastra - A15-217

Supervisor: Simon Ting
Assessor: Steve Ling
Major: Mechanical Engineering Major BE and BEDipEngPrac

Polymerization is a process of combining or joining multiple small-size molecules to form large molecules. Technically, polymerisation is a process of converting monomers to polymers. In the industry, free radical polymerization (FRP) process has been the key to produce more than 50% of commercial polymers. Tolerance to impurities and its versatility are the main factors that FRP has been very successful in the industry (Matyjaszewski 2003).

Compartmentalization and templating effects in polymerization process is the focus of this project. Compartmentalization effect is divided in two phenomena, they are segregating and confined space effects. Segregation is a condition whereby two components are compartmentalized in two different separate environments. By isolating the components, the chance of chemical interaction occurred between two components can be eliminated, resulting in greater control over the polymerization process (McHale et al. 2012). In addition, templating effect has been studied and observed to help improving polymerization process. It was reported that templating effect is able to improve the control in polymerization process, along with segregation effect.

This project aims to investigate if segregating effect is the only governing parameter in the generation of well-defined high molecular weight polymers. Reversible Addition Fragmentation chain Transfer (RAFT) polymerization is the technique that is applied in this project due to its versatility in aqueous dispersed systems. Polystyrene-block-polyacrylic acid diblock copolymer will be synthesized via RAFT polymerization to generate well-defined micelles, termed as ‘Nanoreactors’. It was investigated that the concentration of block copolymer in solvent when preparing nanoreactors is crucial. At higher concentration, nanoreactors with uniform sizes was achieved. Further improvement throughout all processes still should be carried out to extend the credibility of the investigated results.


Investigation of Fatigue Properties of Direct Metal Laser Sintered Parts for Automotive Applications - (12cp)
Kate Nicholas - A15-197

Supervisor: Terry Brown
Assessor: JC Ji
Major: Mechanical Engineering Major BE and BEDipEngPrac

Direct Metal Laser Sintering (DMLS) is an Additive Manufacturing (AM) method included in what is colloquially known as “3D printing”. DMLS creates parts directly from 3D CAD models by sintering powdered alloys in layers ranging 20-40µm. The alloy compositions developed for DMLS are comparable to existing alloys and grades, however there is very little published data on fatigue properties of DMLS parts. The aim of this project is to contribute new knowledge relating to the fatigue behaviour of DMLS parts.

DMLS has commercial applications in mass manufacture, with industry leaders in Automotive, Aerospace and Biomedical using DMLS for mass production of parts and custom tooling. This report examines the suitability of DMLS Stainless Steel GP1 for automotive applications and how the automotive industry can further utilise and adapt their design process for AM. Stainless Steel GP1 was chosen for this project for its strength to weight ratio and financial considerations.

The existing standard specimens for fatigue testing have traditionally been designed to be machined from billet material, which can have up to 70% waste. In this project, the advantages of 3D printing were investigated to minimise the cost of DMLS parts, while still maintaining the integrity of the standard test specimens. The final design reduced the specimen weight and production costs by 65%.

The objective of the study is to perform a repeated and reversed stress test with a mean zero stress fatigue test using Stainless Steel GP1. 14 horizontally printed specimens were tested using the Staircase Method and these were compared with 3 vertically printed specimens.

Testing results identify the Endurance Limit of Stainless Steel GP1 and recognise the relationship between stress and the number of cycles to failure. This relationship is graphically represented by an S-N Curve. This information was then contrasted and compared with known curves for standardised specimens and materials.
Dynamic Rugby Union Scrummage Training Machine – Actuation System Design - (12cp)  
Daniel Orlovich - A15-097

Supervisor: David Eager  
Assessor: Chris Chapman  
Major: Mechanical and Mechatronic Engineering Major BEBBus and BEBSc

In all different levels of rugby union, scrums can be the deciding factor of the match and can simultaneously be one of the most dangerous aspects. Placing a lack of importance in scrummaging practice can lead to a team that is inept in their scrummaging ability as well as causing a high injury-prone environment. Innovations into dynamic rugby union scrum machines can offer a way to improve union team’s performance of all levels while concurrently reducing the number of neck and spinal injuries that occur in scrums through more proficient training.

A scrum machine that dynamically pushes back against the players and places the scrum force correctly on the appropriate parts of the player’s torso can be developed through proper understanding of the scrum. Understanding all aspects of the scrum, currently used scrum machines, and how exactly players participate in both live scrums and scrum practice is fundamental to designing a more effective training facility.

To be able to design such a machine, research has been done into the force application of players in a scrum and scrum density simulating materials for torso contact. An investigation into current dynamic actuation products has also been accomplished to achieve a scrum machine design that is more effective in training, safety, and in affordability than current scrum machines on the market.

This study presents data gathered from scrum player’s force application and their opinions on the different density front-end materials that were tested are presented in the report along with other professional player’s and coaches’ experience with current scrum machines they have previously used. Recommendations on scrum machine designs, materials, and products are presented for a dynamic rugby union scrum machine that can heighten player performance and safety in training and on the field.
In multistorey buildings, especially in seismically active areas, concrete shear walls are used to provide lateral stability for the structure. These are primarily the lift core however, can extend into the outer segments of the structure in a variety of configurations. The large lateral forces associated with wind, or seismic activity, fluctuate with time and the response of the structure is difficult to determine due to the inherent chaotic nature. One of the most critical responses of a structure is the structures ability to absorb the energy induced by the seismic activity. This ability to safely endure large, inelastic deformations is defined as the structures ductility. This thesis will look at classifying the ductility of a structural wall construction system, against the Australian Standard 3600, American Concrete Institute Standard, and the Eurocode 2 Standard.

Design codes around the world define and establish a classification system of the ductility response of a structure, mainly in the early design stages with minimum reinforcement areas. To ensure that the structural wall system designed and used by Dincel meets these specifications a finite element model has been generated to determine its dynamic response. These results will be the foundation of the classification process, which will determine the success or failure of the structural wall system in relation to the three design codes.

This investigation will utilise finite element modelling techniques to obtain vital results and information regarding the response of the structural wall system. The ductility classification obtained from each of the Design Standards will be the foundation for the discussion. The classification and the success of the Dincel system will be examined and recommendations for further investigation provided based on each design code. This information will be beneficial to Dincel to ensure the success of the Structural wall system.
Mechanical Design of a Mobile Robot Platform for Pipe Inspections - (12cp)
Nikhil Pardeshi - A15-195

Supervisor: Teresa Vidal Calleja
Assessor: Michael Behrens
Major: Mechanical and Mechatronic Engineering Major BE and BEDipEngPrac

Urban environments such as Sydney rely on an immense pipe network system to serve the needs of the community. As these cities get older, so do their large pipe networks. Some of these pipes have been buried in the ground a century ago. Pipe bursts can affect traffic condition, private property and impact on people daily activities. Consequently, there is more and more need for fast, accurate analysis of these pipe networks to check the present condition of these pipes and their usability. A way to tackle this important issue is to replace all pipes, but that will be an expensive exercise that can also cause disturbance to local community and road traffic flow.

Increasing need for the maintenance of these pipes and industry’s inability of meeting this need is the motivation behind this project. The University of Technology, Sydney has been involved in a project that aims at solving this issue in conjunction with companies that own these long-standing large scale pipe networks. A small part of this project is to develop moving platform that is capable of inspecting these pipes from inside without the need of extensive human intervention.

The overall aim of this capstone project is to design and develop a mobile robotic platform that is able to navigate inside these old large pipe networks to collect a series of sensors data in order to analyse the present condition of a pipeline section.

The steps followed in the design process are; understanding the objectives and criteria, study and selection of propulsion method, preliminary calculations and sketches, outer body material selection, battery selection, motor and gear selection and preliminary CAD model. The proposed moving platform will assist research in understanding novel techniques for inspecting pipe networks.
Application of Lean Principles in Civil Engineering Processes - (12cp)
Hartley Pike - S15-016

Supervisor: Anne Gardner
Assessor: Hasan Akpolat
Major: Civil Engineering Major BE and BEDipEngPrac

‘Lean’ principles were developed from shop floor observations within companies such as the Toyota Motor Corporation. The revolutionary impact that these principles had on the manufacturing industry prompted their transfer to applications in health care, services businesses and construction project management. However, since being introduced to the construction sector the lean body of knowledge has yielded limited success and faced many barriers to implementation. The identified disparity between implementation in the manufacturing and construction sectors is the likely root cause for the undistinguished performance in a civil engineering context to date. The goal of this research project is to reposition lean thinking away from the current top down approach as a project management tool in the construction sector. Hence, the practical component of this project aims to demonstrate that changing the way that lean methods are applied in construction will yield significant productivity benefits through reducing or removing waste and non-value adding work.

Experimentation with construction processes was conducted on two different Lend Lease Engineering construction sites. Process durations ‘before’ & ‘after’ application of lean thinking were recorded. Furthermore, two interviews were conducted with professionals in the Australian construction industry, both of whom understand the application of lean thinking. Studying concrete paving with lean ‘eyes’ revealed the amount of opportunity to improve through removing waste and non-value adding activities. Applying lean knowledge through process experimentation during the production of precast concrete members quantified the predicted outcomes. As a result, the duration of some steps in these fundamental production/construction processes were reduced by up to 40%. This research project has shown that the lean body of knowledge can be applied in the construction sector at fundamental process level and yield significant time savings.
Improving Social Acumen through Purpose-built Video Games - (12cp)
Allan Pooley - A15-160

Supervisor: Peter Leijdekkers
Assessor: Valerie Gay
Major: ICT Engineering Major BE and BEDipEngPrac

Video Games have become an increasingly prominent part of recreation over the decade. As video games evolve and advance, they have shown the capacity to explicitly and implicitly teach their players to understand mechanics, patterns and concepts.

A commonly observed trait among children and adults with Autism Spectrum Disorders (ASD) is a deficit in the ability to connect socially, identify the emotions of others and communicate effectively. It may be possible to embedding the content that could help people better understand social and communication skills within a video game.

Utilising a multidisciplinary team with expertise in engineering, computer science, psychology and video game enthusiasm, our project is aimed at building such a game. Rather than building from scratch our project seeks to create video game content by modifying already popular video games.

Our first piece of work begins with a ‘Social Scenario’ designed within The Elder Scrolls V: Skyrim, which provides mechanisms for allowing the player to have conversations that dynamically change depending on the input of the player. Characters in the game can be manipulated to project certain facial expressions and body language.

The project seeks to create a tangible video game learning resource that can be trialled with adults on the Autistic Spectrum, collect quantifiable evidence on how effective our video game content was and present a more accessible and feasible framework for creating educational video game content.
The Effect of Flow Rate on the Vibration of a Pump System - (12cp)
Hayden Puckeridge - A15-019

Supervisor: JC Ji
Assessor: Chris Chapman
Major: Mechanical Engineering Major BE and BEDipEngPrac

Vibration based flowmeters are an emerging technology that use pipe vibration to measure flow rate. Flow rate sensors using vibration have been demonstrated to excel in situations where other types of flowmeter are not effective.

This experimental study investigates the relationship between flow rate and pipe vibration identified in current literature for a wider range of parameters. It also analyses the sources of vibration in an axial-flow pump loop and how they are affected by a changing flow rate.

The University of Technology, Sydney pump test loop was used to measure the various components of vibration that occur in an axial-flow pump system. The frequency response was measured at a number of locations on the loop to examine how these vibrations propagate and change under differing operating conditions.

Expanding upon existing work in this area, the study investigates the vibration of both straight and 90° bend pipe sections. It also compares the trends of vibration that occur when the flow rate is altered by changing the pump speed or by throttling a valve.

This report determines that further development in the field of vibration flowmeters is promising, although not without complications. This new technology has the potential to introduce devices to the market that are considerably cheaper, more versatile and easier to install than other non-invasive flowmeter alternatives. In addition the results provide the University of Technology, Sydney with valuable information about the operating conditions of their pump.
Accurate measurement of volumetric gas flow in industry is fundamental in maintaining efficiency and fairness to both providers and consumers. Rotary flow meters measure the volumetric flow of gas and are often employed by the natural gas industry in Australia. Such devices generate and are affected by pressure oscillations, which adversely affect their accuracy and in some cases greatly restrict the range over which they can operate.

The National Measurement Institute (NMI) is mandated to uphold Australian measurement standards in line with world's best practice, it is the desire of NMI to broaden its understanding of the causes of resonance within rotary flow meters in order to expand its understanding of the phenomena as well as potentially increase the accuracy of the calibrations that it undertakes.

The system in which rotary flow meters operate can generate pressure oscillations due to various phenomena, which include acoustically induced vibrations, vortex shedding, and blade-pass frequency vibrations. When these vibrations match the natural frequencies inherent in the system, resonance can occur. Resonance in rotary flow meters has long been observed, but not well researched. Thus the purpose of this thesis will be to identify the causes of resonance and dampen them. The primary focus will be to design and construct a muffler in order to dampen sound induced oscillations which may be present in the system.

Industry currently relies on higher end rotary flow meters which cost upwards of $30 000, as they are minimally affected by resonance due to their larger masses and sturdier design. It is the hope that through damping the pressure oscillations that occur downstream of the rotary flow meters, much cheaper meters can achieve the accuracy of those that are up to three times the cost.
In-Plane Analysis of Structures using Finite Element Modelling - (12cp)  
Vivek Rajagopal - A15-027

Supervisor: Emre Erkmen  
Assessor: Ali Saleh  
Major: Civil Engineering Major BE and BEDipEngPrac

Finite Element Modelling is a technique that is used ubiquitously in engineering to model and simulate solid materials and fluids. The technique is used in Structural Engineering to analyse structures that are subject to external forces to determine the resulting displacements and stresses within the structure. Its use in the industry is growing in complexity and prevalence as computers become cheaper and computationally more powerful. FEM programs that exist today can perform a wide variety of detailed analyses such as iterative design optimisation, non-linear analysis, dynamic analysis and more. This project will focus on in-plane analysis of two-dimensional structures using static and dynamic analysis.

A structure is modelled in FEM using "nodes" and "elements". The nodes define the geometry through position vectors, and the elements define how these nodes will displace under external forces through the "stiffness matrix". In this project, the nodal displacements and element behaviour will be considered in-plane only (displacements in two-dimensions). There are a wide variety of element types from simple springs to three-dimensional block elements. Different elements can be used to more accurately and more effectively model a particular structure.

The aim of this Capstone project is to investigate the effectiveness of a Triangle element with drilling rotations in a wide variety of modelling cases. The Triangle element has three nodes and each node can move horizontally, vertically and rotationally. This allows the element to display a total of nine degrees of freedom and more accurately capture how a structure will displace. The modelling cases considered will test a number of different structures and conditions, including dynamic cases. The results of the triangle element is compared to using a Timoshenko beam element and sometimes an exact result (for simple cases). Through an analysis of these modelling results, the performance of the Triangle element will be discussed to determine its usefulness and issues in modelling different structures and external conditions.
Impact of Resource Efficiency Practices on a Major Infrastructure Company - (12cp)
Ashwini Ranjithabalan - A15-248

Supervisor: Huu Hao Ngo
Assessor: TBA
Major: Civil and Environmental Engineering Major BE and BEDipEngPrac

The growing awareness of environmental impacts of the construction industry has increased the demand and pressure on contractors to provide more sustainable construction practices that reduce environmental impacts. The heightened environmental focused customer coupled with the depletion of raw materials and higher construction costs has resulted in the need for contractors to focus on waste prevention and resource efficiency strategies within the business.

Waste is generated throughout the construction project life-cycle through internal and external decisions therefore strategies to improve the engineering supply management chain to place focus on waste prevention and resource efficiency can lead to a reduction in carbon footprint and cost savings for the business and client. A proactive strategy that aims to focus on waste prevention results in non-value waste streams analyzed in order to find a potential value. This capstone aims to gain insight into proactive strategies that reduce waste within the engineering supply chain of a Tier 1 Contractor (T1C).

Currently engineering supply chain management looks into environmental aspects by either guiding or incentivizing suppliers to operate in a sustainable manner or choosing suppliers based on a number of criteria’s which also include environmental aspects. The research undertaken within this capstone is a practical investigation into the perceptions and the likely influence on waste reduction and resource efficiency of various engineering supply chain management plans from supplier incentives, supplier evaluations and supplier relationship and responsibilities. The perspectives within a Tier 1 Contracting company were evaluated as well as the perspectives of suppliers to T1C and other T1C business’s to provide a benchmark, understand perspectives and establish an effective engineering supply chain management plan based on best practice. The investigation found that the most effective strategy to induce resource efficiency throughout the supply chain was to focus on supplier development with the support of incorporating supplier evaluation criteria’s.

The key findings discovered through multiple case evaluations of various contractors and suppliers that a collaborative approach is essential to implementing effective waste reduction strategies into the supply chain. T1C perspectives as well as suppliers and comparative contractors indicated that sharing the responsibility of waste prevention and resource efficiency was required in order to achieve strategy goals. The capstone identified that a significantly holistic approach from engineering supply chain management is best practice. Recommended strategies are integrated questionnaires for design, tender and engineering teams within the T1C and supplier and a top down management approach that strengthens supplier development and education on how the responsibility of waste prevention can be effectively shared throughout the T1C supply management chain.
Application of SCADA system for the Process of Wastewater Treatment - (12cp)
Fahim Rawnak - A15-224

Supervisor: Huu Hao Ngo
Assessor: Wenshan Guo
Major: Electrical Engineering Major BE and BEDipEngPrac

There has been much debate around the globe regarding the matter of whether there is enough fresh water for the rapid growth of residents. One of the main issues that have struck humanity is the availability of clean and fresh drinking water. This issue concerns the health and safety standards of the growing population. However, conserving water is one of our most important duties rather a responsibility.

Over the years, water has been polluted by the use of industrialization, dumping, and all sorts of littering. To take actions, several measures are used to tackle the situation. Through various processes of treatments and computerized control system, we are progressing to the availability of fresh water. The industrial treatment systems go through several processes such as Primary treatment, Secondary Treatment and the Tertiary Treatment. The computerized system overlooking the process is called the SCADA system, which in abbreviation means Supervisory Control and Data Acquisition.

SCADA is very useful when it comes to efficiency through minimizing fault response time, reducing planned downtimes and by isolating and locating faults. Moreover, it maximizes profitability by reducing failures, operation overhead and reducing the needs of manpower. However, not only it takes care of the profitability but it also maximizes the safety for public and the site itself. SCADA applications have a downfall as well as it has the risk of external interference (hacking). However, modern SCADA systems are now designed to increase the system security in order to reduce the interference.

The use of SCADA into the modern wastewater treatment system is very important as mentioned above. As years pass by, the demand for fresh water will rise but we need to take care of our resource as fresh water is scarce, and as technologies advance, there will be more processes in near future.
Design for Manufacture of the Downhole Equipment for the Rod Drive Hand Pump - (12cp)
Paul Riley - A15-073

Supervisor: John Dartnall
Assessor: Terry Brown
Major: Mechanical Engineering Major BE and BEDipEngPrac

Each year, millions of people in developing nations sicken and die as a result of inadequate access to clean water. The efforts of various humanitarian agencies and growing awareness of this issue has led to a push in recent decades for the supply and installation of hand pumps throughout these areas in an effort to provide access to safe groundwater to those affected. It should be noted that this issue does not solely reside in the third world; many of those living in rural areas of developed countries such as Australia and the United States share a similar dependence on groundwater. Though the technology of the hand pump has existed for years, currently utilised designs exhibit multiple flaws and/or limitations in terms of functionality, longevity and serviceability.

This project first briefly examines the background and importance of hand pumps and looks at several more popularly used designs in terms of capability, functionality and limitation(s). Following this, the concept of the proposed dual acting, deep draw pump and its development is discussed in greater detail, focussing on:
- Drive options (hand, solar, motorised etc.)
- Double-acting design (pumps on both up- and down-stroke)
- Stroke length
- Maximum depth

The primary goal of this project is the development of a complete unit design of the pump downhole equipment intended for use with a variety of wellhead designs including extended-stroke solar and mechanical drive systems, ready for prototype production and testing. This incorporates the development and/or analysis of:
- Mechanical functionality
- Design feasibility
- Component design
- Manufacturing techniques
- Unit assembly, installation and serviceability
- Unit specification, capacity and longevity
- Material and component costing

Ultimately this project is by nature a specific solution to a widespread and fundamental humanitarian issue, aiming to further develop an existing technology capable of better providing access to safe water to those in need.
Implementation of Remote System on Protection Rig (12cp)
Jeyaprathap Saravanapavan - A05-999

Supervisor: Li Li
Assessor: Steven Su
Major: Electrical Engineering Major BE and BEdipEngPrac

SEL (Schweitzer Engineering Laboratories) is one of the largest company to ensure the safe, reliable, and economical delivery of electric power around the world. Most of the electrical industries are using SEL product in Australia. The main purpose of this capstone project is to set up a lab session for future students, so when they graduate from UTS they will have experience using the industry equipment. My project will support to monitor the power transmission which is already built by my supervisor Dr Li Li. This project is based on two protection relays which are contributed by SEL to UTS.

1. SEL-421: Protection, Automation, and Control System
2. SEL-487E: Transformer Differential Relay

The main task of this project is to bring up these two relays into network, so it can be accessed remotely with higher speed to identify the faults in power transmission. Through this project I have found that SEL-421E has an Ethernet interface which supports up to 100 Mbps and SEL-487E has an optical interface which can be accessible up to 1Gbps. With limited resources I have managed to get SEL421 into the network so it can be accessed remotely. SEL487E required optical interface switch to bring up in the network.

During this process, I have set up a computer in a lab as a server which is connected to SEL421 via Ethernet using protocol Telnet. This server can be accessed remotely via VPN (Virtual Private Network) to change the setting of the relays or monitor the relays by another user. I have also developed faults scenario through RRTS and tested SEL421. For this project, I have used two major software:

- AcSELerator QuickSet: This is management software for those relays, once communication is established between servers and relays, relays can be managed by this software to configure and monitor.
- SEL5401: It’s a simulation software which can only be used for RRTS to simulate the power transmission failure.

In my report, I will also provide the details on how to establish the communication for SEL-487E via optical interface. With my project’s result and report, IT department can then develop a software to access these relays via the server for multiple access which will support the future students.
Removal of Heavy Metals from Storm water by the Implementation of Permeable Pavements along the Road Surface (12cp)
Panagoda Seneviratne - A15-202

Supervisor: Saravanamuth Vigneswaran
Assessor: Jaya Kandasamy
Major: Civil and Environmental Engineering Major BE

With the increase in population and urbanisation, the use of impervious surfaces has increased significantly. This had resulted in the generation of a higher volume of stormwater runoff. Furthermore, the generated stormwater consists of a significant number of pollutants due to vehicle emissions, pollutants from the atmosphere, animal waste, pollutants which have leached from metallic surfaces such as gutters etc. At the moment, stormwater together with these pollutants gets flushed into streams or sewers without any conservation or treatment. An innovative solution for this situation is the utilisation of permeable pavement systems replacing the traditionally used impervious pavements, which would facilitate rainwater infiltration while reducing the surface runoff. However, permeable pavements have a limited capacity to remove heavy metals from stormwater.

This capstone project will study the widespread applicability of permeable pavement systems as a sustainable stormwater management and groundwater recharge mechanism. Furthermore, the heavy metal removal capacity of a permeable pavement system with the utilisation of zeolite will be studied. In order to determine the efficiency of zeolite, batch experiments with single metals, Nickel, Cadmium, Copper, Lead and Zinc were conducted with a likely rainwater pH of 6. The Langmuir maximum adsorption capacities at initial concentrations of 10 mg/L were 1.3, 2.5, 3.0, 4.8, and 7.3 mg/g for Zn, Cd, Ni, Cu, and Pb, respectively at 10-3 M NaNO3 ionic strength. Next, pilot scale testing of a permeable pavement system comprising of zeolite will be analysed. The batch results will be used to explain the mechanisms of adsorption in pilot scale testing. In order to determine the heavy metal removal potential of the system throughout the lifecycle of a permeable pavement system, an accelerated loading method which represents the 1300mm of annual rainfall in Sydney will be implemented together with adjusted Australian stormwater heavy metal concentrations.
Gasworks were historically used from the 1800's to produce town gas used for heating, lighting, cooking and industrial purposes, with the last gasworks plant in NSW being decommissioned in 1985. Due to gasworks operating in a time prior to the introduction of comprehensive environmental legislation, combined with a lack of understanding of the detrimental effects of site contamination issues, waste products produced were often buried or released, thus leaving a legacy of contamination at gasworks and adjoining sites.

Currently the NSW EPA has identified over 60 gasworks sites that are likely to require remediation due to the prospect that these sites contain or are likely to contain carcinogenic and highly toxic contaminants.

Currently the technologies seen suitable to remediate these sites are limited due to the chemical nature of the contaminants, with the technologies of thermal treatment and disposal to landfill almost exclusively being seen as the preferred options. These technologies, however, when examined from a sustainably perspective, have many unfavourable aspects.

However an emerging technology that is beginning to be used at gasworks sites and has many favourable aspects when considering sustainably is enhanced bioremediation.

While conventional bioremediation has historically been seen as unsuitable due to the contaminates present, this analysis does not adequately consider recent advances in enhanced bioremediation techniques that aim to stimulate and enhance microbial activity through the addition of microorganisms, amendments and other compounds that affect and can limit treatment in their absence.

This project will analyse the current state of enhanced bioremediation and how it is being used to remediate gasworks sites and associated regulatory factors, as well as examine the current research that looks to further improve the performance, sustainability and suitability of enhanced bioremediation.
Process Tailoring and Systems Modelling for the “Design Develop and Qualify the Solution” (DDQS) Process - (12cp)
Sijjal Tasneem - A15-144

Supervisor: Ravindra Bagia
Assessor: Mary Walmsley
Major: ICT Engineering Major BE and BEDipEngPrac

The Avionics business unit at Thales Australia develops training capabilities ranging from high-fidelity mission-critical system to low-fidelity systems that can be optimised in a classroom environment. The business develops solutions to given problems using the Design Develop and Qualify the Solution (DDQS) process, seeking to achieve customer satisfaction with consistent needs of the stakeholders. This research aims to evaluate the DDQS process, focusing on any tailoring required to make it suitable to resource constrained R&D applications, and to the R&D methodology prevalent within the business.

Informal discussions, guaranteeing anonymity, were held with the stakeholders using the “existing” system and process in order to glean any issues, lessons learnt, and problems with the system. These discussions revealed a need to develop a consistent, yet cost-effective, process for the application of the DDQS to R&D applications. Using the outputs of the discussions, a risk analysis was conducted to identify the shortcomings and loopholes in the existing process, so that these may be addressed in the process proposed via this research.

Due to the need to achieve consensus among the stakeholders, a soft systems approach was used, together with the development of theoretical models and a literature review. An in-depth, qualitative analysis was undertaken to explore themes of interests about existing and intended processes. These included consideration of the types of reviews, lifecycle models and testing strategies. An iterative approach was developed to address concerns apropos limited time and resources.

The research effort resulted in a re-design of the process, with suitable tailoring to allow its application to R&D projects. This proposed process is currently being reviewed by the relevant Thales stakeholders with a view to recommending its adoption by the business.

Ideas for further work on this project include overlaying agile project principles on the proposed process, as found in the Recommendations section of the report.
Timber in Residential Buildings: Malaysian Timber - (12cp)
Tieng Hor Tiu - A15-187

Supervisor: Rijun Shrestha
Assessor: Yancheng Li
Major: Civil Engineering Major BE and BEDipEngPrac

Sustainable development and green design has become the major concerns in current engineering practice, especially in the construction industry. This is due to the continuous growths on human population and the demand of residential building is keeping on increasing over the century. Civil engineers played an important role on designing and selecting sustainable materials for residential building. There is always an argument on timber as a sustainable building material between the environment lovers and engineers. Timber use is very common in residential buildings in developed countries but not in developing countries.

This report is to demonstrate that timber is sustainable and appropriate to use as common construction material in residential buildings. This report provides research on the environment impact of timber compared with other modern construction materials such as steel, aluminium, and concrete. Timber classification and species of Malaysian Timber will be introduced in this report. Furthermore, application of timber and new timber technology will also be discussed in the report.

The research and findings show that timber is a sustainable construction material. It has less negative environment impact compared to other modern building materials. Timber is suitable to use as a green building material. New Cross Laminated Timber technology has unlocked the limitation of high-rise timber building in the past. CLT technology provides more stability and durability for the high-rise timber building. It also has excellent seismic, fire, noise and heat insulation performance. Lack of timber knowledge is the major challenge on promoting timber to be used in residential building in developing countries like Malaysia. Educating the public and professional in developing countries will gives a push on using timber in residential building.
GNSS Development Pack for the Simplelink Sensor Tag - (12cp)
Martin Trainer - S14-045

Supervisor: Steven Su
Assessor: Li Li
Major: Electrical Engineering Major BEBBus and BEBSc

Wireless communication technology, embedded systems and numerous types of electronic sensors have reached such a small-scale, become so inexpensive and readily available that it finds itself present in the daily life of most people. The most evident implementation of this technology has been to create smart devices that provides users with the ability to access and record data from numerous sources that may be either located on the person or in a remote location. Through the networking of these smart devices, we can realise ‘the internet of things’ that offers a multitude of applications.

One such smart device is the Simplelink SensorTag produced by Texas Instruments which integrates eight sensors with a low-power Bluetooth radio. It utilises a cloud-based open-source application available on android and iOS platforms to make the data from multiple units available to the user in real-time. Furthermore, it can be used as a development platform by offering the option to attach external hardware via a breakout header and the ability to program the microcontroller through JTAG debug pins.

The objective of this capstone project is to design and implement a development pack for the SensorTag that adds a Global Navigation Satellite System and UV sensor to the host of sensors available. It is intended to be primarily used in conjunction with the on board gyroscope as an Inertial Measurement Unit for the analysis of human gait and fall detection to assist in medical research at UTS by Dr Steven Su. The secondary application is its use as an education tool in the subject 48033 Internet of Things by offering an exercise in the programming and networking of the sensors featured on the development pack.

The scope of this project is the hardware and firmware design of the GNSS development pack. An off-the-shelf GNSS module and digital UV sensor have been implemented as a PCB that plugs directly into the SensorTag. An on-board battery power supply is used to accommodate the high-current draw of the GNSS receiver while keeping the device portable. To accommodate the increase of data produced by the development pack, flash storage and USB connectivity is included so the device may act as a data-logger. It was also intended that the existing cloud-based application of the SensorTag be developed to include real-time readings from the GNSS and UV sensor.
The Design of a Counter Flow Air-To-Air Heat Exchanger Test Rig - (12cp)
David Tran - A15-091

Supervisor: John Dartnall
Assessor: Guang Hong
Major: Mechanical Engineering Major BE and BEDipEngPrac

In the modern society, energy efficiency is a growing concern especially for the Heating Ventilation and Air Conditioning (HVAC) industry. In the last 10 years, data centre facility managers have observed a rapid increase in energy and power trends which continue to double every 5 years (Belady, 2013).

Some data centres around the world have implemented an indirect evaporative cooling system in lieu of a conventional vapour compression refrigeration system to improve energy efficiency. There are huge improvements in the Coefficient of Performance (COP) in the indirect evaporative cooling system which is known to achieve a COP of up to 30 mainly due to the efficient heat exchanger. A conventional vapour compression refrigeration system in the same application has a COP of only 3-4.

John Dartnall is working on designing and manufacturing a counter flow air-to-air heat exchanger system. His main 3 objectives is a heat exchanger design that can:
1. achieve exceptionally high COP/efficiency in a smaller footprint,
2. work in humid environments in a hybrid configuration with conventional vapour conventional systems at an exceptionally high COP/efficiency previously unattainable.
3. reduce the overall costs of materials and installation, e.g. associated ductwork and water equipment,
4. be able to be mass produced at lower costs.

This Capstone project explores the data centre environment and its physical properties. It also examines conventional vapour compression refrigeration and indirect evaporative cooling systems, air conditioning psychrometrics, heat exchangers and test rig facilities. In considering this research, I have designed a test rig to be incorporated in the UTS Air Conditioning and Heat Transfer Laboratory located in Building 11, Level 10, Room 403. This test rig will be used for future testing of John Dartnall's patented heat exchanger. This design will enable the evaluation and analysis of the heat exchangers energy efficiency for future production.
Strengthening Unstable Local Unsealed Road Pavements using a New Stabilisation Technique - (12cp)
Kevin Tseng - A15-004

Supervisor: Hadi Khabbaz
Assessor: Behzad Fatahi
Major: Civil Engineering Major BE and BEDipEngPrac

The Wingecarribee Shire Council is a regional council located south western of Sydney, NSW. There is a vast portion of its road network is categorised as unsealed regional roads, which incurred significant cost in road maintenance every year. As a result of budget cut from the State Government and increasing number of requests and demands from local communities, the Council’s Maintenance Branch must reform its strategy and approach in order to meet Fit for the Future.

This project focuses on pavement stabilisation techniques, road geometric and pavement structural design targeting a typical Shire unsealed roads. The process begins in study of relevant topic and related field practices carried out by other researchers or expertise in this specialised area around the world. This project chosen a soil stabiliser called Polycom Stabilising Aid, which is a type of polyacrylamide. In accordance with supplier, it is not a newly introduced product in the market however it is new to Wingecarribee Shire.

A series of laboratory experiments were conducted at University of Technology Sydney Soils Laboratory. The experiments aimed at measuring the optimum moisture content and the maximum dry density; as well as evaluating the unconfined compressive strength of untreated and modified soil specimen with lime to soil ratio: 100:3, 100:6 and 100:8. For Polycom (a new soil stabiliser) with Polycom to soil ratio: 100:0.0002, 100:0.0004 and 100:0.001. All soil specimens were tested after given curing durations of 7 and 28 days.

A strip of Inverary Road was proposed for Polycom stabilisation trial. A construction drawing based on 3-D modelling and cost estimate was also prepared. This project is to propose new stabilisation technique and road pavement design in dealing with unstable local unsealed roads. If successful it will reduce Council’s annual maintenance cost, and result in achieving financial sustainability for long-term.
LITERARY REVIEW OF AGING STRUCTURES THAT HAVE UNDERGONE REMEDIATION: EXPLORING REPURPOSED STRUCTURES AND POSSIBILITIES - (12CP)
VALANTIS VALASOUNDIS - A15-249

Supervisor: Chris Wilkinson
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The repurpose and remediation of aging structures is essential in preserving identity and cultural heritage. In the Australian context, more and more structures and sites are facing disrepair and redundancy, and an overall decision has to be made regarding redevelopment of the land or structure; the outcome providing benefits and disadvantages respectively. Throughout this report I will conduct a literary review of aging structures that have either undergone or currently undergoing remediation. Various facets be will addressed including challenges, solutions, benefits and justifications through primary and secondary research. The literary review will explore in detail two specific case studies of repurpose projects including: Irving Street Brewery Yard Building, and Waratah Mills. The exploration and analysis throughout will aid in providing a justification for my third case study; the redevelopment of Allied Mills, a prospective project that will commence in the near future.

I will explore the challenges and solutions involved with remediating industrial heritage; all of the case studies have been industrial in the past, although the findings involved with repurpose and remediation could apply to any aging structure located in Australia. Structural design aspects will be focused on as well.

The original form is essential in the preservation of the structure’s cultural value. In essence, the notion of making old to new, reinvigorating the original environment without creating entirely new infrastructure is ideal, as it appears to be more of a sustainable option for the future.

The necessity to either remediate or build new becomes an unavoidable decision. I believe preserving the environments could be more beneficial for society, and rejuvenating current structures is the more economical and environmentally friendly avenue to pursue. Therefore, throughout my literary review and exploration of the two case studies, a strong argument could be put forth into the redevelopment of Allied Mills.
Ashur Varde - S15-182

Supervisor: David Eager
Assessor: Chris Chapman
Major: Mechanical Engineering Major BEBADipEngPrac

Neuroplasticity in rehabilitation has incited new research and development for devices that can treat stroke victims in such a way that they completely recover a skill rather than the traditional method of compensation. Constraint-Induced treatment is a method that stimulates connections in the motor cortex, by placing the patient in a forced environment using machines. Over time, the patient will be provided less and less assistance until they are capable of performing the task themselves. Currently, this method is under research focusing on gross motor skills mainly walking.

A device that can take the philosophy of current research that focuses on fine motor skill recovery will allow exploration of new methods of rehabilitation. This device will act as a platform in the exploration of new treatments for stroke victims. As the major deliverable of the project is to produce a prototype, a number of ideas have been explored and synthesised to address issues in rehabilitation. If successful, a final product will be able to assist in the recovery in fine motor skills of the patient’s dominant hand. Current methods involve tedious and specific exercises for each flexor in the hand. This results in a lack in conformance from the patient and a risk of never recovering. However, the act of writing produces real time outcomes that are easily identifiable in real-world situations. This will allow the patient to observe tangible results in contrast with traditional methods of exercise.

This study describes the design and development of this prototype with the assistance of literature and knowledge provided by both supervisors who cover injury prevention and rehabilitation engineering in their own research.
Manufacturing any product requires the movement of the product from one place to another. This process is known as materials handling. This operation of moving products or components can be from micro items such as watch components to items as large as cars or even bigger. Borg Manufacturing, the key stakeholder in this project, manufactures a large variety of different products. They require a similarly sized array of different material handling equipment. The materials required to be moved range from 4 metre long pine logs to 60mm wide by 300mm long pieces of laminated medium density fibreboard (MDF) and everything else in between.

In an ever expanding industry suppliers like Borg Manufacturing need to be constantly expanding to keep up with the demand for their products. Borg Manufacturing produces products primarily for the building industry in Australia. These products include MDF, laminated board, cupboard doors and custom made benchtops and shelving components. To increase supply all aspects of the business need to expand, starting with the manufacture of MDF, as the current processing procedure is slow and laborious.

This project is the design of a conveyor system that handles the primary resources of the manufacture of MDF, these resources being four metre long pine logs. The design includes four different conveyors, locating and supporting a drum debarker and other necessary components for the conveyor system to perform its primary objective.

A drum debarker is a large drum about four metres in diameter and about thirteen metres long. A debarker is used to remove the unwanted bark from the pine logs before the logs are sorted and then chipped. This type of debarker works by allowing the logs to be rotated inside the drum, while the internal structure of the drum knocks the bark off the logs, similar to a ball or rod mill. The chipper is a large series of blades which chop the pine logs into small common sized chips of wood, these are processed into wood fibres which are then pressed into MDF.
The Electrification of the UTS Formula SAE Vehicle – Battery Pack Design and Motor Specification for an All-Wheel-Drive Powertrain - (12cp)
Clyde Webster - A15-031

Supervisor: Peter Watterson
Assessor: Youguang Guo
Major: Mechanical and Mechatronic Engineering Major BE and BEDipEngPrac

The Formula SAE-A competition is undertaken in the context that students are working for a design firm that is designing, fabricating, testing and demonstrating a prototype vehicle for the non-professional, weekend competition market. A current trend in the market is the switching from internal combustion engines to electric powertrains; with hub mounted powertrains being the forefront of electric drivetrain technology.

The intention of my work is to advance two key aspects of the electric vehicle design namely:
• To design, build and test the first revision battery pack for use in the 2015 competition
• To specify and explore the feasibility of a hub-mounted powertrain that is justified in terms of both cost and performance

The 7.2 kWh battery pack (otherwise referred to as the accumulator) weighs in at approximately 80 kg and has a main structural component is made of sheet steel. The cells being used are LiFePO4 20 Ah pouches from A123 which are distributed amongst the pack five segments. The nominal output voltage is 356.4 V, which is the accumulation of the 108 cells, all wired in series.

The feasibility of specific motor parameters is determined through the study of previous cars developed by UTS combined with the study of the performance characteristics of motors currently being used in industry and in the competition worldwide. The continuous power and torque ratings for the specified motors are calculated to be 5 Nm and 4.3 kW respectively, with the ability to output short regular stints (< 3 s) of up to 18 Nm and 20 kW. It is intended that the motor with a max RPM of 20,000, be mounted on the chassis side of the wheel package and connected via a 2-stage planetary gearbox with a final ratio of 13.84:1.
Supervisory Control and Data Acquisition (SCADA) systems consists of human machine interface (HMI), remote terminal unit (RTU), data acquisition, programmable logic controller (PLC) and communication network. It can supervise and control all equipment or other remote system. The SCADA system operators use HMI to control the system directly in order to process and analyze information from the field. The centralized servers transported and ran the real time processing of field data and the control system HMI, and it controls the flow data between the human machine interface (HMI), controllers and field equipment.

The project is a group project and its objective is to design a heat’s temperature regulator by using SCADA system. The whole system separate to two parts which are hardware and software and this report focuses on software by using Vijeo Citect which can control and test the temperature regulator. In the system, it has two switches which can control fan and heater, and there are four ADAM models used in project which is 6017, 6022, 6015 and 6050. The hardware is connected to these ADAM and link to the computer though a cable. After that, comparing these ADAM models and controlling them under one system, that is, SCADA system can achieve using one system to control all facilities in a remote terminal. In the project, the temperature can be controlled in setting value and it has some errors about 1.5 degree and we will add a PID controller to reduce the error.

The SCADA system study provides students the opportunity to develop the new technology during the design process and it will popular to all electrical system in the future. We will write our learning experience and make a PPT which can help other students study the SCADA system.
An Investigation into the Effects of Sampling Rate on Head Impact Criteria - (12cp)
Emily White - A15-135

Supervisor: David Eager
Assessor: Chris Chapman
Major: Civil Engineering Major BE and BEdEngPrac

Impact attenuating surface (IAS) materials are used in children's playgrounds within Australia to limit the hazard presented to children's safety when using playground equipment; the largest hazard being head impact injuries. In order to maintain the risk-taking environment of children's playgrounds, which is very important for decision making and taking risks, surfacing material should have qualities that reduce potential injury as much as possible when risk taking result in a fall. The current Australian / New Zealand Standard 4422:1996 details the measurement of head impact criteria (HIC) including the sampling rate at which measurements should be taken.

Having adopted the sampling rate of 8000 Hz from historically automotive testing, an investigation into the effects of sampling rate specifically for measuring head impact criteria for playground surfacing can be of value to AS/NZS 4422:1996. Hence the purpose of the project was to conduct an investigation on rubber IAS samples in laboratory conditions as well as in playground settings on bark and sand, to measure if changing the sample rate higher or lower than 8000 Hz made a difference to the HIC recorded and ultimately if the suggested sample rate should be revised.

The project has successfully answered its hypothesis by modelling the changing HIC value with sampling rate, showing the logarithmic curve that varying sample rate creates. The start of the plateau of the log curve was at approximately 8000 Hz for rubber at any height and therefore in accordance with the value of 8000 Hz in AS/NZS 4422:1996. Following this initial finding, the project explored the effects of different height drops and material types as well as sampling rate in order to determine if material type or height of drop had any significance to the effects of changing the sample rate.
Effects of Bacteria on Physical Properties of Cement Treated Soft Soil - (12cp)  
Xinyi Wu - A15-233

Supervisor: Behzad Fatahi  
Assessor: Hadi Khabbaz  
Major: Civil Engineering Major BE and BEDipEngPrac

Considering the land scarcity and construction cost, geotechnical engineers are aiming at improving the performance of soils by combining using various techniques. Design and construction engineers keep exploring new methods to improve soft soils in terms of the stiffness and strength. Recent research shows that bioengineering techniques have great potential to improve the soil properties for infrastructure construction. The soil bioengineering techniques is an effective tool for stiffening the soft soil. Furthermore, these techniques have good economic effects on soil improvement and treatment. Thus, bioengineering techniques will be widely practiced around the world for treating problematic soils.

The purpose of this project is to stiffen soft clays using biological techniques using a bacteria, which is used on transplants and rooted cuttings applications. The project is focusing on the verification of whether the bacteria has impact on the physical properties of the cement treated soil including density and moisture content. In this project, 45 samples were prepared to measure the physical properties with time during the curing process. Three different cement contents of 10%, 15% and 20% and five diverse bacteria contents of 0%, 0.5%, 1%, 2% and 5% by weight of soil will be used in the experiment. All the samples are sealed in the plastic bags during curing to avoid moisture loss. Variations of both wet and dry densities as well as the moisture content with both cement and bacteria contents are discussed.
Design, Manufacture and Test a New Dewpoint Meter - (12cp)
Mehdi Zeinali - A15-198

Supervisor: Guang Hong
Assessor: John Dartnall
Major: Mechanical Engineering Major BE and BEDipEngPrac

National Measurement Institute (NMI) desires to be able to calibrate systems with a low dewpoint (DP). The system requirement is to be able to accurately generate air with the dewpoint reaching to -50°C. Having such a generator with these capabilities is very important for NMI as the work was undertaken overseas, due to the lack of capabilities within Australia.

It was a challenging project to work on, as there were no other systems at NMI that could generate DP less than -30°C. This means there wasn’t enough knowledge in the field and lots of research was required. The success of this project could save industry partners a lot of time for their calibrations. It could also help the humidity department do further research in the field. It was suggested to make the first prototype using available resources to test the concept and proceed with final manufacturing if successful.

The result of this project was impressive based on the expectation and available resources. A system was designed and manufactured using equipment available at the NMI labs for most of the progress. The approach was quite different to what can be found in similar projects around the world and yet it had a very high efficiency. The first prototype reached almost -30°C DP and the principal was proved to be working for the DP of -50°C.

The available prototype that has been manufactured proves the design and principals are reliable. It can help NMI and industry partners to be independent for low DP applications and it will provide a solid base for further research. Manufacturing the final product is underway in order to reach the DP of -50°C.
Foundations are critical parts of structures, and the soil that supports the foundation is equally important. Mechanical properties of soils vary significantly due to various compositions and structural loads, thus soft soils may need improvement to perform well under the applied loads. Several ground stabilisation methods have been developed to improve the performance of soils. In Australia, Portland cement is predominantly adopted in the market as a low-cost soil stabilizer which can be used for most of the soil types. With the advent of biogeochemical applications, sometimes additives such as bacteria may impact the soil strength and be used as an effective ground improvement technique to achieve both economical and environmentally-friendly results.

Some bacteria can improve the soil using calcite precipitation. However as soil may contain organic matter, it is difficult to have single bacterium strain, and therefore, various bacteria existing in the soils may alter the expected results. The purpose of this project is to analysis the impact of existing soil bacteria on shear strength of cement treated clay, as well as the relationship between the bacteria and stabilizer in clay. This experiment research is aiming to determine the effect of the selected bacteria on the shear modulus of cemented clay through comprehensive set of bender element tests on 45 soil samples. These soil samples were prepared with cement content of 10%, 15% and 20% by weight of soil, and to investigate the effect of the bacteria, five different bacteria content were employed. Test results show that soil stiffness is significantly influenced by bacteria and cement contents.
There are many problems with brake pad wear sensor in the current version. For example, the electronic brake wear sensors should be changed whenever the pads are replaced. And, the materials become worn during the service time, and this can affect their functionality. Also, to ensure the performance throughout the life of the pads, it should be frequently replaced with a new sensor. In order to address these issues, a digital version for the brake wear detector will be developed as my innovation project in final year project.

Based on the project, when the driver needs to brake, the system applies a force through the piston to push brake pad touch the rotated disc. And when the driver releases the vehicle pedal, the brake oil flows back into oil tank and afterwards the spring force and suction force will haul the piston back to initial position. Thus, if the detector can measure the forward movement displacement directly. The brake pad wear level can be represented as the difference between standard value and measurement value.

In the detection process, if the brake pads go slightly further forward, the moving distance will change. A rope has been connected at the back of the brake pad to translate the distance value to the resistance value. The brake pad’s life span can be detected through access to different resistance circuits (potentiometer). The circuit will detect the different values of Current and Voltage. Based on the programming and reading values, this device can determine whether the brake pad needs to be changed or not.

Through this project, the new version of digital brake wears sensors II add the safer feature on many vehicles used to warn the driver when the vehicle’s brake pads are near end of service life.