Department of Civil Engineering

Research Topics ~ 2019

Faculty: Faculty of Engineering	**Department:** Civil Engineering	
Lecturer: Prof Jan Wium Mr Chris Jurgens	**E-mail:**	janw@sun.ac.za cj@sun.ac.za
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Field of Research: Construction Engineering and Management

General Description ***(field of research):***

Research in Construction Engineering and Management focuses on the fields described below. The aim is to perform applied research which can serve as basis for improved performance in the South African construction industry. This is accomplished by improvement in various aspects of the industry, ranging from skills development, construction methods, risk management, identification of hurdles and shortcomings, through to management of large projects. Research often includes interaction and feedback from practitioners in the industry.

Pre-fabrication in construction has the advantage of faster delivery of large projects, improved construction quality in certain aspects, and potentially improved construction safety. In South Africa relatively little use is made of pre-fabrication in construction projects. Although the concept may be well developed and applied for structural steelwork application, not many construction projects in reinforced concrete are carried out using pre-fabrication.

Municipal and national infrastructure needs careful coordinated planning, implementation and maintenance. Although infrastructure management procedures have been well developed and documented, these are not necessarily applicable to the local industry. South Africa has a shortage of infrastructure financing, but also of managerial skills to implement provision of infrastructure and to maintain existing systems.

All projects have risks. Although risk management procedures have been developed and are widely used, these are often seen from the perspective of individual project participants. Information is required on risks experienced by different project participants in the South African context, and procedures need to be developed which will enable collaborative risk management on projects.

Procedures to direct the process of design to suit construction requirements need to be identified and defined. Information which is of practical use for designers need to be documented in such a way that constructability can be incorporated along specific guidelines during the design process.

Large projects often exceed the anticipated project cost and duration. This may be related to a variety of factors and procedures which are investigated in this research.

	List of Research Topics:	**MEng**	**PhD**	**Funding**
1	Hybrid Concrete Construction (prefabrication plus in-situ): • Design and fabrication standards for hybrid concrete construction • Hybrid concrete construction: Transport and erection practices • Behaviour of connections in hybrid concrete construction under seismic loads	X		Refer to the notes below
2	Construction Risk: • Risks for South African consultants on design-build projects	X	X	Refer to the notes below

	• A study to quantify a methodology to determine appropriate professional fees for construction projects • Risk based tendering methods			
3	Infrastructure Asset Management: • Community involvement in IAM • Optimizing the asset portfolios of State Owned Enterprises • Investigation into a sustainable model for management of low cost housing	X		Refer to the notes below
4	Design management and large projects: • A study on the failure of large projects : Compilation of project data (case studies) and a synthesis on lessons learned • The use Building Information Models to verify tacit knowledge to address project constructability	X		Refer to the notes below
5	Management & Modern Technology: • Investigate how modern technology may be used to assist in improving project execution (e.g. the use of drones in construction management) • Modern Communication systems and their impact on Projects Management • Using modern technology to improve quality of construction of low cost housing	X	X	Refer to the notes below
6	Social, Environmental & Sustainability studies: • Rammed Earth Construction in South Africa • Development of a risk management strategy to ensure that SA is ready for climate change • Corporate Social Investment towards improving the Construction Industry	X		Refer to the notes below

Notes regarding Funding:

- Industry organisations offer bursaries for postgraduate studies in Construction Engineering and Management if the student meets their profile requirement. These organisations generally expect that the student would work for them for the period that the bursary was awarded. Make contact with the lecturer for further information.
- The Division has one new bursary available for 2019 deserving students. The bursary will be awarded based on undergraduate academic achievement.

Prerequisites or Requirements:

- Average of 60% mark over the 4 years of under graduate studies.

Faculty: Faculty of Engineering	**Department:** Civil Engineering	
Lecturer: Dr Johann Andersen	**E-mail:**	jandersen@sun.ac.za
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	Office:	S472

Field of Research: Intelligent Transport Systems

General Description *(field of research):*

Intelligent Transport Systems is the application of data, analysis tools, communications technologies and control techniques to the field of Transportation Engineering to improve efficiency, mobility, safety and operations. Various systems make up the toolbox of ITS, including Freeway Management System (FMS), Advanced Public Transport Management System (APTMS), Traveller Information Systems and Corridor Management.

The Smart Mobility Lab (SML) was established in 2014 as a state-of-the-art facility at Stellenbosch University to assist in research and implementation of technology applications in the transportation engineering arena. It is jointly managed by Dr Johann Andersen and Megan Bruwer. The vision of the SSML is to provide a world class platform for the research and development of smart mobility solutions that promote sustainable, safe and optimised transport within the developing country context, using Stellenbosch as a practical test-bed. The SSML has key partnerships with industry and planning authorities. Through our partners, the lab collaborates with international leaders in their respective fields and similar laboratory facilities, allowing access to data, software, hardware and expertise.

The research focus of the SML is aligned with four key areas:

1. **Smart City:** A Smart City uses data, information technology and communications to optimise infrastructure usage and improve service efficiency. The SSML aims use Stellenbosch as a test bed for “Smart City” principles.
2. **Big Data:** The application of innovative data sources to transport planning. Data generated by probe vehicles, blue tooth sensors, smart phones and RFID technologies are being implemented with Transportation Engineering.
3. **Transport Modelling:** Improved traffic modelling and simulation methods using alternative data sources.
4. **Transport of the Future:** the future of Transportation Engineering lies in the Connected Vehicle environment and a new paradigm of transport MaaS (Mobility as a Service). It is important to research the applicable of these future transport applications in the developing country context.

Dr Andersen’s research focus is the application of new data sources to transport planning network models, and the future of transportation, particularly in the field of Connected / Autonomous Vehicles and MaaS.

	List of Research Topics:	**MEng** *(Research)*	**PhD**	**Funding**
1	Application of Floating Car Data sourced Origin-Destination (OD) information to Transport Demand Models	X	X	Refer to notes below
2	Key Performance Indicators (KPI) for transport systems in development countries	X		Refer to notes below

3	MaaS: the positioning of Electric Vehicle Microtransit in the public transport environment	X		Refer to notes below
4	Connected / Autonomous Vehicle: industry readiness in South Africa	X		Refer to notes below
5	Smart City Application for Stellenbosch: New data sources result in a more in depth understanding of the transportation system. This information would be invaluable to the travelling public if made available. This project will entail the development of an App to collect and disseminate transport related data.	X		Refer to notes below

Notes regarding Funding:

- There are industry organisations that offer bursaries for postgraduate studies which may require students to work for them for the period. Make contact with the lecturer for further information.
- Some Department of Transport bursaries are available for postgraduate study. Make contact with the lecturer for future information.
- The SML receives support from a number of international and local industry partners. They support particular research projects through access to data and software, as well as training.
- Funded international exchange opportunities are available with research partners of the SML.

Prerequisites or Requirements:

- Average of 60% mark over the 4 years of under graduate studies.

Faculty: Faculty of Engineering	**Department:** Civil Engineering	
Lecturer: Prof Kim Jenkins	**E-mail:**	kjenkins@sun.ac.za
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Field of Research: Pavement Engineering – Sustainable Road Construction Materials

General Description ***(field of research):***

The Pavement Engineering Group at Stellenbosch University (SU) is addressing the need for sustainable practices in the maintaining of South Africa's road network infrastructure. Amidst increasing environmental consciousness and societal challenges holistic solutions are needed that do not compromise on performance. Four of the innovative ways that SU's research is contributing to this is highlighted here:

Cold recycling technology

Research into the bitumen stabilisation of recycled granular, cemented and asphalt materials and blends of these materials has shown that:

- the load bearing capacity and durability of old road materials is significantly enhanced using emulsion and foamed bitumen as binders; and
- emissions can be reduced by up to 40% and energy consumption by more than 50% with cold stabilisation; and
- robust long term performance should be considered with increasing recycled asphalt percentages.

Construction and demolition materials (NOT waste)

A large proportion of construction and demolition material are disposed of in landfills ignoring potential inherent value of materials. Research has found that:

- characterisation and performance evaluation of Recycled Concrete Aggregate (RCA) and Recycled Masonry (RCM) has proven to have significant potential for use in load bearing pavement layers in a road; and
- can provide enhanced structural performance through self-cementing characteristics, based on residual active cement.

	List of Research Topics:	**MEng**	**PhD**	**Funding**
1	Innovations in new material development and new technologies e.g. Warm Mix Asphalt WMA, Nano-tech	X		R80,000 for 2 years
2	Cold recycling technology development: Research of highly modified cold mixes for high performance	X		R80,000 for 2 years
3	Recycling of construction materials (crushed concrete and masonry) and by-products (slag, glass etc)	X		R80,000 for 2 years
4	Life Cycle Assessment LCA methods' applicability within the South African context.	X		R80,000 for 2 years

Notes regarding Funding:

- Funding is not guaranteed, as yet. It depends on the NRF and industry support from standard bursary providers. Some bursaries have requirements including commitments to working-back periods after completion of the degree.

Prerequisites or Requirements:

- Average of 60% mark over the 4 years of undergraduate studies.

Faculty: Faculty of Engineering	**Department:** Civil Engineering	
Lecturer: Mrs Megan Bruwer	**E-mail:**	mbruwer@sun.ac.za
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	Office:	S471

Field of Research: Transportation Engineering

General Description ***(field of research):***

Transportation Engineering provides solutions to the mobility needs of society. This includes private and public transport, freight movement, transportation system management and infrastructure design. Transportation Engineering integrates scientific principles and technology to plan, design, analyse, operate and manage transportation systems. Transportation Engineers work in a dynamic environment and are involved in diverse projects, including public transport planning, urban planning, transport accommodation of developments and traffic network design; all reinforced with principles of safety and accessibility.

The Smart Mobility Lab (SML) was established in 2014 as a state-of-the-art facility at Stellenbosch University to assist in research and implementation of technology applications in the transportation engineering arena. It is jointly managed by Dr Johann Andersen and Megan Bruwer. The vision of the SSML is to provide a world class platform for the research and development of smart mobility solutions that promote sustainable, safe and optimised transport within the developing country context, using Stellenbosch as a practical test-bed. The SSML has key partnerships with industry and planning authorities. Through our partners, the lab collaborates with international leaders in their respective fields and similar laboratory facilities, allowing access to data, software, hardware and expertise.

The research focus of the SML is aligned with four key areas:

5. **Smart City:** A Smart City uses data, information technology and communications to optimise infrastructure usage and improve service efficiency. The SSML aims use Stellenbosch as a test bed for “Smart City” principles.
6. **Big Data:** The application of innovative data sources to transport planning. Data generated by probe vehicles, blue tooth sensors, smart phones and RFID technologies are being implemented with Transportation Engineering.
7. **Transport Modelling:** Improved traffic modelling and simulation methods using alternative data sources.
8. **Transport of the Future:** the future of Transportation Engineering lies in the Connected Vehicle environment and a new paradigm of transport MaaS (Mobility as a Service). It is important to research the applicable of these future transport applications in the developing country context.

Mrs Bruwer’s research focus is the application of new data sources to improve the traditional Transportation Engineering environment. Particular interest is in traffic operations management, real time traffic management, and new data measurement tools for Traffic Flow Theory.

	List of Research Topics:	**MEng** ***(Research)***	**PhD**	**Funding**
1	Intersection Level of Service from Probe Data: Level of Service (LOS) has traditionally been estimated using traffic volume data applied to a delay function. Delay can however be determined from actual vehicle	X		Refer to notes below

	movements. This study will consider a model to directly obtain LOS at intersections from Floating Car Data.			
2	Variation in Floating Car Data Penetration: The representation of Floating Car Data varies on different road classes, within different geographic areas and during the day. This variation needs to be quantified.	X		Refer to notes below
3	Traffic management platform for a small city Traffic Management Centre: TMC operations are prohibitively expensive. This research considers best practice for small city environments to also benefit from traffic management.	X		Refer to notes below

Notes regarding Funding:

- There are industry organisations that offer bursaries for postgraduate studies which may require students to work for them for the period. Make contact with the lecturer for further information.
- Some Department of Transport bursaries are available for postgraduate study. Make contact with the lecturer for future information.
- The SML receives support from a number of international and local industry partners. They support particular research projects through access to data and software, as well as training.
- Funded international exchange opportunities are available with research partners of the SML.

Prerequisites or Requirements:

- Average of 60% mark over the 4 years of undergraduate studies.

Faculty: Faculty of Engineering	**Department:** Civil Engineering	
Lecturer: Prof Celeste Viljoen	**E-mail:**	cbarnardo@sun.ac.za
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Field of Research: Structural reliability and standardisation; Risk based decision making

General Description ***(field of research):***

We do research in the field of structural reliability and standardisation; as well as risk based decision making. The focus is on probabilistic description of structural systems, including model uncertainty, resistance- and load models; assessment of structural reliability including existing structures, ultimate limit state and serviceability limit state applications; and structural standardisation as a tool for risk optimal implementation.

We have a number of suitable software packages and high performance computers available for structural modelling and reliability assessment. Our structural laboratories are state of the art and enables testing as required. We collaborate with several leading European groups in this field.

List of Research Topics:		**MEng** ***(Research)***	**PhD**	**Funding**
1	Reliability assessment of cold formed steel beam columns designed using the direct strength method: Reliability of CFS columns in axial compression was found to be insufficient for the global buckling failure mode. Extend the investigation to include CFS beam columns; and recommend adjustments to improve the situation.	x		TBC
2	Provisions for assessment of existing reinforced concrete bridges: The treatment of existing bridges need consideration. TMH7 are being revised and design bridge loading may increase. Deterioration also necessitate decisions regarding rehabilitation. Since the remaining design life of an existing structure is shorter it may be argued that lower target reliability levels may be acceptable. Applicability of methods from fib Bulletin 80 should be considered and adapted if need be for application to RC bridges.	x		TBC

Notes regarding Funding:

- n/a

Prerequisites or Requirements:

- Standard departmental requirements (60%)
- Academically strong candidates willing to develop the topic to PhD level will be given preference.

Faculty: Faculty of Engineering	**Department:** Civil Engineering	
Lecturer: Prof Gideon van Zijl	**E-mail:**	gvanzijl@sun.ac.za
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Field of Research: Structural mechanics, computational mechanics, durability mechanics, 3D printing of concrete

General Description ***(field of research):***

A team of 6 PhD and 6 MEng students annually do research in this team, in the Centre for Development of Sustainable Infrastructure (CDSI). The themes of research are

1. 3D printing of concrete, including lightweight foam concrete, high-performance concrete, and nanotechnology to modify the concrete thixotropy required for high construction speed. By this 4th Industrial Revolution technology development, we intend to industrialise construction, and grow the South African Construction Industry with sustainable careers and career paths.
2. High-performance façade structural engineering, to develop energy-efficient building skins.
3. Retrofitting of
   a. Unreinforced load-bearing masonry low-rise buildings in the Western Cape, susceptible to collapse in seismic events.
   b. Alkali-silica reaction affected concrete dams, for instance Kleinplasie dam in Jonkershoek, by computational analysis of the performance of retrofitting strategies, incorporating the damaged and cracked state, fluid-structure interaction and an expected seismic event.

For international collaborative projects, we are recruiting 3 PhD positions for 2019-2021, one in each of the above fields. They will work in teams with the related MEng-positions for 2019-2020 described below.

	List of Research Topics:	**MEng** ***(Research)***	**PhD**	**Funding**
1	Structural design for 3D printing of concrete: Join the 3DPC research team, with particular focus on the standardisation of structural design for 3DPC structures. Consider state-of-the-art standards and guidelines such as Eurocode 2 and Model Code 2010, in conjunction with the new SANS51992, and develop guidelines to be incorporated in these standards for 3DPC.	X	X	Contact Prof Gideon van Zijl
2	Structural analysis and repair strategy for an ASR-damaged dam structure: The Kleinplasie dam in Jonkershoek suffers from Alkali Silica Reaction, which has led to swelling and cracking. Study the stability of the dam. Use the finite element modelling strategy developed by a current PhD-student in Abaqus to model the damaged wall under a seismic event. Propose a repair strategy to improve stability.	X	X	
3	Façade engineering for sustainable building infrastructure:	X	X	

	A current M-study is proposing high-performance facades for buildings towards minimal energy consumption. Various green star rated buildings are investigated with commercial software DesignBuilder V5. Extend the study on facades to consider embodied energy, which is the energy consumed in the manufacturing of the facade construction material. Repeat selected energy performance analyses to re-classify high-performance facade, given full energy (embodied plus operation) consumption.			
4	Structural design of retrofitting of unreinforced masonry buildings for seismic resistance: Leading research is performed in Stellenbosch on a shotcrete retrofitting strategy for low-medium rise masonry buildings in the Western Cape region, to improve seismic response. Various three and four story residential buildings may perform poorly and collapse in a seismic event of extent expected in the region. Use the experimental and finite element-based data on individual walls developed thus far, to develop design guidelines for the retrofitting of full buildings. Verify the strategy through appropriate analytical and finite element analysis.	X	X	

Notes regarding Funding:

- Contact Prof Gideon van Zijl in this regard.

Prerequisites or Requirements:

- Standard departmental requirements (minimally 60% weighted average for relevant BEng or BScEng degree)

Faculty: Faculty of Engineering		**Department:** Civil Engineering	
Lecturer: Mr Pierre van der Spuy		**E-mail:**	pierrevds@sun.ac.za
		Tel:	+27 (0)21 808 3761
		Office:	S319

Field of Research: Bridge engineering, Traffic load modelling, Renewable energy structures

General Description ***(field of research):***

	List of Research Topics:	**MEng** ***(Research)***	**PhD**	**Funding**
1	Developing software for design of wind turbine foundations: Develop a software tool in Java or equivalent to automate the design of wind turbine foundations. The software will perform all calculations with only basic input parameters and generate design reports and construction drawings automatically in a BIM environment. The design method will be compared with a non-linear model in DIANA to determine its conservatism, or lack thereof.	X		TBC

Notes regarding Funding:

- Funding is currently being negotiated with industry, but not guaranteed.

Prerequisites or Requirements:

- Standard departmental requirements (60%)

Faculty: Faculty of Engineering	**Department:** Civil Engineering	
Lecturer: Dr Riaan Combrinck	**E-mail:**	rcom@sun.ac.za
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Field of Research: Structural Engineering – Construction Materials

General Description ***(field of research):***

The characteristics of fresh and young concrete have a significant influence on both the mechanical and durability properties of hardened concrete. Fresh concrete refers to concrete that has just been cast while young concrete refers to concrete only a few days old and the characteristic to investigate include: deformation, defects, rheology as well as mix design. Due to the wide scope of this field, the current focus is on the prevention of early age cracking of concrete, since the presence of these early cracks can have a major detrimental effect on the service life of any concrete structure. The research activities include research on plastic settlement cracking, plastic shrinkage cracking and thermal cracking of fresh and young concrete and are aimed at providing guidelines as well as the understanding needed for the prevention of early age cracking of fresh and young concrete. There is also a focus on rheological properties of fresh concrete and identifying compatibility issues between cement and admixtures.

	List of Research Topics:	**MEng** *(Research)*	**PhD**	**Funding**
1	Rheological concrete properties required for successful concrete placement: One of the main advantages of concrete is its ability to be shaped into any form while in the fresh state. However, defects such as honeycombing, segregation and incomplete compaction still occur during the placement process and have a significant negative impact on the overall cost and durability of any concrete structure. The successful casting and placement of concrete requires a concrete with suitable fresh properties for a specific application. The rheology of concrete provides a more scientific description of the fresh properties of concrete compared to the conventional slump test. This study should investigate the impact of rheology of fresh concrete on the successful casting and placement of numerous conventional and non-conventional concrete mixes. This can also include identifying compatibility issues between cement and admixtures.	X	X	TBC
2	Early age strength development of conventional and non-conventional concrete mixes exposed to different environmental conditions: Modern day concrete structures needs to be constructed quickly and effectively. The concrete must reach a specific strength as fast as possible to allow the stripping of formwork and supporting falsework. However, structural collapses can occur if the falsework is removed before the concrete has reached the required strength. With this in mind, this study should investigate the strength	X		TBC

	development with time of both conventional and non-conventional concrete mixes at different environmental conditions. This should include a variation in formwork type as well as cement type.			
3	Quantifying the effectiveness of preventative measures for the cracking of plastic concrete: The cracking of plastic concrete can result in serious and premature durability issues. However, these cracks can be prevented using preventative measures such as admixtures, fibres, SAP, curing, finishing techniques and casting procedures. These measures are often ineffective due to incorrect application. This study should investigate and quantify the effectiveness of these measures in preventing or reducing the cracking of plastic concrete.	X		TBC

Notes regarding Funding:

- Please discuss with lecturer for more details.

Prerequisites or Requirements:

- Standard departmental requirements (60%)

Faculty: Faculty of Engineering	**Department:** Civil Engineering	
Lecturer: Dr Richard Walls	**E-mail:**	rwalls@sun.ac.za
	Tel:	+27 (0)21 808 9584
	Office:	S375B

Field of Research: Structural fire engineering, fire behaviour & modelling, informal settlement fire safety, construction materials behaviour in fire (steel, timber, concrete, etc.)

General Description ***(field of research):***

The Fire Engineering Research Unit (FireSUN) is the first university fire research team on the African continent. It is involved with research in a wide variety of areas ranging from informal settlement fire safety, to building design for fire, and fire testing. In 2019 a masters in structural fire engineering (SFE) and fire safety engineering will be launched. In 2019 the group will have 1 postdoc, around 5 PhDs and 6 MEng students working on various projects. The modules MEng students will take are:

- Core modules: Fire dynamics
  Structural fire engineering, along with either of the following -
- Civil students: Advanced steel design
  Advanced concrete design
- Mechanical students: Advanced heat transfer
  Computational fluid dynamics

	List of Research Topics:	**MEng** ***(Research)***	**PhD**	**Funding**
1	Modelling of structures in fire for simplified analysis and design: Composite steel structures in fire are normally designed using full FEA models, but now a simplified approach using a single, intelligent beam element has been developed at SU for this purpose. Develop the element for analysing structures in fire, especially full 3D structures.	X	X	Company linked competitive bursary to be sought. TBC.
2	Investigating the use of multi-storey timber buildings for South Africa considering fire resistance: Multi-storey timber buildings are a sustainable alternative to normal construction, but have significant fire risks. Consider locally available materials and analyse whether such timber structures are suitable for our market.	X	X	
3	Full-scale testing & modelling of informal settlement shacks in fire: Join an international research team developing fire safety for informal settlements. Carry out full-scale burn tests of specially made shacks. Develop fire spread and burning models. Consider social aspects and influences of the larger problem.	X	X	
4	Design of a smoke alarm for informal settlements: Develop a smoke alarm suitable for informal settlements in Africa which is highly robust, but also has the required sensitivity. Use existing electrical systems but modify housings and airflow to make them insect resistant, cost effective and technically suitable.	X	X	

5	Forensic investigations after informal settlement fires: Research and develop methods for analysing how forensic investigations after informal settlement fires should be conducted.		X	

Notes regarding Funding:

- Contact Dr Richard Walls for more information

Prerequisites or Requirements:

- Standard departmental requirements (minimally 60% weighted average for relevant BEng or BScEng degree)

Faculty: Faculty of Engineering	**Department:** Civil Engineering	
Lecturer: Mr Tata van Rooyen	**E-mail:**	asvr@sun.ac.za
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Field of Research: Material and Structural Mechanics

General Description ***(field of research):***

A research programme in Stellenbosch University was launched to develop and characterize lightweight foam concrete (LWFC) for structural application. A particular aim is to develop the material with sound mechanical and durability properties for structural application in load bearing walling systems of low to medium rise residential infrastructure. The benefits of thermal and sound insulation make it an ideal construction material for residences in hot or fluctuating climates. In particular, it's low self-weight may be exploited in regions of seismic activity, leading to lower inertia forces in earthquake ground acceleration. Having been in use for nearly a century, its use has been dominantly for non-structural insulation and backfill for drainage. In the past decade it has received renewed attention as potential structural material. The research group therefore focusses on the development of LWFC as a durable structural material. This includes determination of the mechanical properties and durability properties of LWFC. The development of LWFC for 3D printing is also being explored.

List of Research Topics:		**MEng** *(Research)*	**PhD**	**Funding**
1	Use of nano particles in foamed concrete: Use nano particles to enhance the mechanical and durability properties of foamed concrete	x		TBC
2	Alkali activated foamed concrete: Use waste products to produce foamed concrete	x		TBC

Notes regarding Funding:

- n/a

Prerequisites or Requirements:

- n/a

Faculty: Faculty of Engineering		**Department:** Civil Engineering	
Lecturer: Prof Trevor Haas		**E-mail:**	trevor@sun.ac.za
		Tel:	+27 (0)21 808 4438
		Office:	S318
Field of Research: Earthquake Engineering			
General Description ***(field of research):***			

	List of Research Topics:	**MEng** ***(Research)***	**PhD**	**Funding**
1	Some areas in the Western Cape are at risk to natural seismicity. The fuel reservoirs at Milnerton refinery each have a capacity of approximately 20 million litres. These fuel reservoirs are considered a strategic resource. Should failure of 1 of these fuel reservoirs occur, it could result in a catastrophe not only for the plant but also have severe consequences on the businesses which heavily rely on fuel in the Western Cape.	X		TBC
2	The new code of practice for the analysis of civil engineering infrastructure was recently approved for use. Many civil engineering professionals had problems using the previous code of practice. The purpose of this investigation is to determine how practicing engineers are embracing the new code of practice.	X		TBC
3	Concrete Filled Double Skin Tubular columns can be used to enhance the construction process and is also viable alternative in seismic prone areas. The aim is to develop a generic FE model to accurately predict the ultimate load capacity of CIRCUCLAR CFDST sections when subjected to eccentric loading.	X	X	TBC
4	Concrete Filled Double Skin Tubular columns can be used to enhance the construction process and is also viable alternative in seismic prone areas. The aim is to develop a generic FE model to accurately predict the ultimate load capacity of SQUARE / RECTANGULAR CFDST sections when subjected to eccentric loading.	X	X	TBC
5	Concrete Filled Double Skin Tubular columns can be used to enhance the construction process and is also viable alternative in seismic prone areas. The aim is to develop a generic FE model to accurately predict the ultimate load capacity of Circular CDFST sections when the Inner tube is eccentric	X	X	TBC

Notes regarding Funding:

- This will be discussed on a one on one basis with prospective candidates.

Prerequisites or Requirements:

- Standard departmental requirements (60%)

Faculty: Faculty of Engineering	**Department:** Civil Engineering	
Lecturer: Mrs Wibke de Villiers	**E-mail:**	wdv@sun.ac.za
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Field of Research: Construction Materials

General Description ***(field of research):*** The environmental impact of the construction industry is a concern and research in the development of eco-friendly construction materials should be a high priority. New construction materials or even just improving conventional construction materials is imperative for a more sustainable built environment. The objective is to both develop new construction materials but also reduce the environmental impact of currently used construction materials. The activities are within the field of alternative masonry units, including material development, structural testing, determining suitable specifications and lasting implementation on a large scale.

	List of Research Topics:	**MEng** ***(Research)***	**PhD**	**Funding**
1	Determining mechanical demands on alternative masonry units for application in Category 1 Buildings: Mechanical limits for conventional masonry units were developed using outdated yield line theory and superseded loading conditions. To assist the development of alternative masonry units, the mechanical demands on masonry units in Category 1 Buildings need to be verified. This is done using finite element analyses, taking into consideration the requirements of SANS 10160, including seismic loading, and the requirements of SANS 10400.	X		TBC
2	Determining the thermal performance of alternative masonry walls: To assist the development of alternative masonry units, the thermal performance of alternative masonry walls must be determined. This is done using an existing hotbox testing facility, which needs to be improved and calibrated to the requirements of ASTM C1363.	X		TBC

Notes regarding Funding:

- All research related costs are covered. Funding for bursaries is still to be confirmed and students are encouraged to apply for external funding sources. Interested students are welcome to discuss the matter with me.

Prerequisites or Requirements:

- Standard departmental requirements (60%)

Faculty: Faculty of Engineering	**Department:** Civil Engineering	
Lecturer: Mr Carlo Loubser	**E-mail:**	carloloubser@sun.ac.za
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	Office:	S408

Field of Research: Water Services

General Description ***(field of research):***

Water services planning issues, with a focus on hydraulic modelling of water distribution systems, pumps and reservoirs. The key focus areas are:

	List of Research Topics:	**MEng**	**PhD**	**Funding**
1	Extended period simulation of water networks, also known as time simulation.	X		Refer to the notes below
2	Intermittent water supply, also known as controlled water supply - referring to pressurised water supply systems that are unable to meet the demand on the system. Modelling systems subjected to intermittent supply, and planning ahead to improve system performance to ultimately meet the peak system demand is a particular challenge.	X		Refer to the notes below
3	Intermittent water supply has many negative impacts, such as surge transients. The study of water hammer and surge, especially in relation to intermittent water supply, is another focus area.	x		Refer to the notes below
4	Modelling of head dependant demand patterns in hydraulic modelling software, in order to better understand demand patterns under conditions of intermittent water supply.	x		Refer to the notes below
4	Small bore sewer systems, also known as solids-free sewers.	X		Refer to the notes below
5	Emergency supply systems designed for fire protection, for example at strategic consumers such as refineries, ports and large industrial complexes.	X		Refer to the notes below
6	Urban hydrology, with specific focus on rainwater harvesting as alternative water source.	X		Refer to the notes below

Notes regarding Funding:

- Students may apply to outside funding sources.

Prerequisites or Requirements:

- Average of 60% mark over the 4 years of under graduate studies.

Faculty: Faculty of Engineering	**Department:** Civil Engineering	
Lecturer: Prof Gerrit Basson	**E-mail:**	grbasson@sun.ac.za
	Tel:	+27 (0)21 808 4355
	Office:	S418

Field of Research: Hydraulic Engineering

General Description ***(field of research):***

- Design of Hydraulic Structures,
- Design of Pipeline & Pumpstation Design
- River & Stormwater Hydraulics

	List of Research Topics:	**MEng**	**PhD**	**Funding**
1	Physical and mathematical (CFD) modelling of the 3D flow patterns at hydraulic structures: • Dam spillway hydraulics • Energy dissipation structures • River abstraction works • Large diameter conduits • Environmental impact minimization	X	X	Refer to the notes below
2	Hydrodynamic mathematical modelling of river systems to investigate aspects such as: • Climate change and land use change impacts • Sediment transport and fluvial morphology • Reservoir sedimentation management • Estuary and Lake hydrodynamics and salinity • Erosion protection	X	X	Refer to the notes below

Notes regarding Funding:

- Students may apply to outside funding sources.

Prerequisites or Requirements:

- Average of 60% mark over the 4 years of undergraduate studies.

Faculty: Faculty of Engineering	**Department:** Civil Engineering	
Lecturer: Prof Heinz Jacobs	**E-mail:**	hejacobs@sun.ac.za
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	Office:	S413

Field of Research: Water Services (Urban)

General Description ***(field of research):***

Water services planning issues, with a focus on end-use modelling of demand, methods for estimating water demand and corresponding analyses. Application of end-use models to address planning issues, including water demand management, water conservation, water loss and alternative household water sources (greywater reuse and garden boreholes).

	List of Research Topics:	**MEng**	**PhD**	**Funding**
1	End-use modelling of residential water demand: stochastical methods for modelling water use by considering water end-uses, also known as micro-components	X		Refer to the notes below
2	Residential outdoor water demand: water use for urban agriculture and relevant issues of climate change, water restrictions and food security.	X		Refer to the notes below
3	The water-energy nexus at home: hot water use in a home and related water temperatures notably impact energy requirements. Both water and energy are viewed internationally as scarce resources, facing increased stress over the next decade.	X		Refer to the notes below
4	Water demand analyses. Automated procedures, online tools and “apps”, and real time applications are increasingly incorporated for demand analyses. Government subsidised low-cost housing developments constitute a growing portion of homes in South Africa, with various challenges in terms of water service provision and densification.	X		Refer to the notes below
5	Research into sewerage flow and sewer hydraulics, particularly as it relates to end-uses of water, water conservation and demand management.	X		Refer to the notes below

Notes regarding Funding:

- Students may apply to outside funding sources.

Faculty: Faculty of Engineering	**Department:** Civil Engineering	
Lecturer: Dr Isobel Brink	**E-mail:**	icbrink@sun.ac.za
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Field of Research: Water Treatment

General Description ***(field of research):***

Water treatment has diverse applications. Current research includes small scale water treatment systems, point of use water treatment, modelling of dissolved pollutants in streams and stormwater quality. Small scale water treatment research is focussed on the optimal combination of different units (aerobic reactor, anaerobic reactor and disinfection) in package plants designed to treat sewage from small housing clusters. Point of use water treatment research is focussed on the optimal combination of low technology settling, filtration and disinfection units for application to rural areas on a single household scale. Modelling of dissolved pollutants in streams is focussed on the comparison of parameters estimated with different models and model solving techniques. Stormwater quality research includes on-site measurement of urban runoff metals and solids pollutants as well as the relationships between pollutants and urban land uses.

Future research envisaged includes general research into stormwater runoff pollutant reduction technologies with a focus on Green Infrastructure and performance of Water Treatment Plant technologies. Stormwater runoff contains many pollutants that need to be reduced before entering natural water bodies. Engineering technologies have not advanced towards this goal and this may be partly attributed to a lack of design information in the form of runoff pollutants as well as a lack of research into the efficiency of stormwater structures. Research will be focussed on (1) determining typical runoff pollutants and (2) investigating appropriate Green Infrastructure technologies to treat polluted stormwater.

List of Research Topics:		**MEng** ***(Research)***	**PhD**	**Funding**
1	Typical roof runoff pollutants	X		See below
2	Biofilter pots for stormwater pollutant treatment		X	See below
3	Investigation into the performance of a new membrane system at the Stellenbosch Wastewater Treatment Works	X		See below

Notes regarding Funding:

- Funding applications for these projects have been done, but the outcomes have not been published at this stage.

Prerequisites or Requirements:

- As per the policies of Stellenbosch University.

Faculty: Faculty of Engineering	**Department:** Civil Engineering	
Lecturer: Prof Kobus du Plessis	**E-mail:**	jadup@sun.ac.za
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	Office:	S410

Field of Research: Hydrology

General Description ***(field of research):***

- Flood
- Drought
- Water resources management
- Climate variability

	List of Research Topics:	**MEng**	**PhD**	**Funding**
1	Partial Duration series vs Annual Maximum series vs Peak over threshold.	X		Refer to the notes below
2	Flood calculation methods review (MIPI / CAPA / I(mm/h) / MAP / ARF / RMF / PMF).	X		Refer to the notes below
3	Flood hydrographs	X		Refer to the notes below
4	Impact of veld fires on runoff	X		Refer to the notes below
5	Storm rainfall analysis (Max observed rainfall / radar data)	X		Refer to the notes below
6	Changes in seasonal rainfall patterns	X		Refer to the notes below
7	Rainfall / Runoff relationships (WRSM)	X	X	Refer to the notes below
8	Yield modelling (WRYM / Mike Basin) (Stochastic data vs Historical data)	X	X	Refer to the notes below
9	Monthly vs Daily time step for modelling	X		Refer to the notes below
10	Alternative water resources	X		Refer to the notes below
11	Integrated catchment management (Instream flow requirements / Reserve))	X		Refer to the notes below
12	Daily stochastic runoff model		X	Refer to the notes below

13	Extension of flow records using tree year rings	X		
14	Investigate cyclic patterns in rainfall / runoff (Solar cycles / ENSO)	X	X	
15	Water resource cost analysis (URV)	X		
16	Re-evaluation of pan-factors (open water (dams) evaporation)	X		
17	Drought analysis	X		

Notes regarding Funding:

- Students may apply to outside funding sources.

Prerequisites or Requirements:

- Average of 60% mark over the 4 years of under graduate studies.

Faculty: Faculty of Engineering	**Department:** Civil Engineering	
Lecturer: Prof Koos Schoonees Dr Andre Theron	**E-mail:**	kooss@sun.ac.za aktheron@sun.ac.za
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	Office:	S410 S414

Field of Research: Port & Coastal Engineering

General Description ***(field of research):***

- Waves, water-levels, climate change (Golwe, watervlakke en klimaatsverandering)
- Marine Structures (Kusstrukture)
- Sediment transport, Coastal processes and Morphology (Sedimentvervoer, kusprosesse en morfologie)
- Shipping, ship motions, ports/harbours (Skepe, skeepsbeweging en hawens)
- Sand spits (Sandtonge)
- Estuaries (Getyriviere)
- Hydrodynamics, Water Quality, dilution and outfalls (Hidrodinamika, Watergehalte, verdunning en uitlate)
- Water supply - coastal/marine aspects (Watervoorsiening – kus/marine aspekte)

	List of Research Topics:	**MEng**	**PhD**	**Funding**
1	Below is a selection of recently concluded research topics that give a good indication of the type of research conducted. • The effect of sea level rise on flood levels in the Great Brak Estuary: assessing the adequacy of a 5 m setback line • Options to reduce sediment build-up in a surf zone trench protected by an open-ended cofferdam • Characterizing long wave agitation in the port of Ngqura using a Boussinesq wave model • Configurations of a piled row breakwater for a protected shallow water marina • A dry port as an expansion option for the Cape Town container terminal • A feasible design concept for the deep water breakwater of the proposed new Durban Dig-Out Port • Hydraulic stability of multi-layered sand-filled geotextile tube breakwaters under wave attack • Methods for determination of coastal development setback lines in South Africa. • Shoreline changes and longshore transport at the Port of Ngqura • An introduction to multifractal geometry of wave sea states on the west and south-east coasts of South Africa • A review of selected small scale seawater intakes in South Africa and an investigation into abstraction from the surf zone on rocky coastlines, by means of the horizontal well method	X	X	Refer to the notes below

	• Water-levels and waves in the south-west Indian Ocean due to cyclones • Size of toe rock for vertical seawalls • Scour underneath vertical seawalls • Effect of overhang length of a recurve seawall to reduce wave overtopping • Conceptual solutions to minimise the effects of cobbles on the sand-bypassing system at the Port of Ngqura • Coastal Erosion and Accretion of Beaches – The Effect of Storm Duration, Water Levels and Long Waves on Selected Numerical Models • A synthesis of the coastal geophysical characteristics of sandy beaches along the SA coastline • Durban Container Terminal: Capacity analysis and feasibility of a dry port concept • SWASH: A robust numerical model for shallow water coastal engineering applications • Monwabisi: a hydrodynamic study of the hazardous cell circulation (/surf zone currents) and potential related solutions to a safer bathing facility. • Three dimensional method for monitoring damage to dolos breakwaters • Evaluation of Storm Surge Components at Saldanha Bay • Berm Height at Temporarily Open/Closed Estuaries in South Africa: Analysis and Predictive Methods • Great Brak Island – measures for flood defence • Limiting the use of rock for Edge Protection in Bahrain by using Geotubes • Effect of the form of the overhang of a recurve seawall to reduce wave overtopping			

Notes regarding Funding:

- Students may apply to outside funding sources.

Prerequisites or Requirements:

- Average of 60% mark over the 4 years of under graduate studies.