Structural Engineering and Civil Informatics Research Topics 2025

Supervisor(s)	Degree	Preliminary title of research project	Brief description of project	Scholarship per year
Prof Riaan Combrinck	MEng [R]/PhD	Carbon capture in concrete using CO_2 Nanobubble infused water	Stable Nanobubble infused CO_2 water can be used to replace the mixing water of any concrete. This is an effective method of storing CO_2 in concrete to lower concrete's environmental impact. This study should investigate the properties and environmental impact of concrete with CO_2 infused Nanobubble water.	Speak to lecturer for funding options
Prof Riaan Combrinck	MEng [R]/PhD	Using South African tree gums/saps as admixture in concrete	The gums of trees are widely used in various industries. This study should test the influence of several gums from trees available in South Africa on the fresh and hardened properties of concrete, with the aim of using these tree gums as admixtures.	Speak to lecturer for funding options
Prof Riaan Combrinck	MEng [R]/PhD	Admixtures for LC2/3 concrete	LC2 and LC3 cements are gaining popularity internationally and locally. These cement have the potential to greatly reduce the CO_2-emissions of the cement industry. However, these cements lower the workability and flowability of concrete. Admixture can be used to solve this problem, but these cements behave differently to admixture compared to traditional cements. This study should determine the most suitable admixtures to be used with LC2/3 cements.	Speak to lecturer for funding options
Prof Riaan Combrinck	MEng [R]/PhD	Air milling of cementitious material	Air or jet milling is an effective method for milling particles without the damage caused by more traditional mechanical milling methods. This study should investigate the impact of using air milled cementitious material on the properties of concrete.	Speak to lecturer for funding options
Dr Jacques Kruger	MEng[R]/PhD	Maximising the specific strength of 3DPC elements	Higher strength-to-weight ratios are preferred in most engineering works. Improve the structural performance of 3DPC elements while reducing their weight. Develop innovative strategies, concepts, and methods and apply these to large-scale experimental tests for validation.	Speak to lecturer for funding options
Dr Jacques Kruger	MEng[R]/PhD	3D printing concrete at heights	3D printed structures are increasingly becoming taller as printing machines increase in size. Investigate what effect pumping to > 10 m heights has on a 3DPC material's properties both in the fresh and hardened concrete state. This study involves pumping concrete up onto the engineering building's roof and then 3D printing it with the best view ever.	Speak to lecturer for funding options
Dr Jacques Kruger	MEng[R]/PhD	Multifunctional infrastructure realised through 3D concrete printing	3D concrete printing offers many benefits that the construction sector has not yet seen previously. The ability to exactly deposit material only where functionally required is the most significant. This allows for the development of multifunctional infrastructure, providing bespoke solutions previously unattainable. Identify, develop, 3D print, and characterise bespoke multifunctional concrete infrastructure.	Speak to lecturer for funding options
Dr Jacques Kruger	MEng[R]/PhD	3D printing real concrete	Most 3D printing that currently occurs in the construction industry uses mortar and not concrete as a material, the distinguishing factor being the inclusion of coarse aggregates in the mix. Develop a real 3D printable concrete and characterise its fresh and hardened state mechanical properties.	Speak to lecturer for funding options
Prof T Haas, Dr AS van Rooyen	MEng [R] / PhD	Determining the effect of replacing concrete with "alternative" concrete for circular slender double skinned tubular columns subjected to eccentric loading.	Concrete Filled Double Skin Tubular (CFDST) columns can be used to enhance the construction process and is also a viable alternative in seismic prone areas. The aim is to evaluate the effects of using "alternative" concrete [i.e. alkali actived material / geopolimers, lightweight foamed concrete] on the mechanical performance of the circular slender CFDST columns subjetced to eccentric loading. The research will be conducted using experimental and FE analysis.	TBC
Dr AS van Rooyen	MEng [R] / PhD	Bio-based composite construction material	Fungi have been used to make mycelium based composite construction material. Use fungi available in South Africa to create mycelium bricks for non-structural to semi-structural application.	Speak to lecturer for funding options
Dr AS van Rooyen	MEng[R]/PhD	Bio-based composite construction material	Select, develop and characterize the properties of mechanical and thermal properties of mycelium based composite material.	Speak to lecturer for funding options
Dr AS van Rooyen	MEng [R] / PhD	3D printed lighweight vermiculite concrete for 4IR application	3D printable lightweight vermiculite concrete has been development in the CDSI-SU. Work alongside a PhD student to further develop 4D printable (3D + 1D phase change material) lightweight vermiculite concrete for 4IR application	Speak to lecturer for funding options

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Dr Jacques Kruger, Dr WI de Villiers, Prof Gideon van Zijl	MEng[R]/PhD	3D printed concrete structural design chapter in *SANS51992-1-1 General rules for buildings*	Join the SU-3DPC team and contribute to the adoption of the technology by the construction industry. From the developments by SU-3DPC, RILEM, fib and ACI technical committees, develop guidelines for design of 3DPC buildings in South Africa. Develop these guidelines as a proposed new chapter in SANS51992-1-1, following the example of Chapters 10, 11 and 12 where additional rules for precast, lightweight aggregate and plain concrete respectively are presented. In collaboration with SU-3DPC members, validate structural design models in flexure and shear.	R140 000
Dr AS van Rooyen, Prof Gideon van Zijl	MEng[R]	Infrastructure durability - Non-destructive and non-invasive in-situ resistivity testing versus laboratory testing	Globally acknowledged SA durability index tests are standardised in SANS and specified for large infrastructure construction. The tests are limited and invasive, requiring concrete cores taken from infrastructure or sacrificial structural elements during construction. Specimens taken from these cores subsequently undergo time-consuming laboratory preparation and testing. Non-invasive, non-destructive test methods are required to complement the laboratory tests, and to enable regular testing over the life span of infrastructure. Investigate resistivity as non-invasive in-situ test, and compare resistivity results to chloride-induced	R140 000
Prof Gideon van Zijl	MEng [S]	Alkali-silica reaction affected concrete structural assessment	ASR is a well-documented deterioration process in concrete. Given significant impact on concrete strength and stiffness, altered structural response to loading actions is expected. Review the performance of ASR-affected South African infrastructure. Propose a matrix of structural engineering condition assessment analyses of affected local reinforced or post-tensioned concrete infrastructure. Include consideration for combined deterioration, for example chloride or carbonation-induced corrosion of steel due to ASR cracking.	No bursary is available for part-time study. Research costs will be paid for.
Prof Gideon van Zijl	MEng [S]	The South African Structural Engineering history	Review structural engineering roots and development in South Africa. Include commercial and residential buildings, bridges, mass and arch dams design and construction. No start date is prescribed, and reference to early local South African structures is encouraged, Consider local development and adoption / adaption of global trends as witnessed by the influence of global design standards in structural timber, masonry, concrete and steel. Identify iconic	No bursary is available for part-time study. Research costs will be paid for.
Dr Humaira Fataar, Dr Johann van der Merwe (UP)	MEng [R]	South African CLT charring rates	Determine charring rates of cross-laminated timber (CLT) from produced from various local plantations across South Africa. Work to be done in collaboration with the University of Pretoria.	Possible bursary available. To be motivated.
Dr Humaira Fataar	MEng [R]	Durability of structural timber	Timber is a valuable construction material due to its high strength-to-weigh ratio, reduced energy consumption, design flexibility, etc. However, unlike its counterpart construction materials (concrete and steel), limited research has been done to investigate its durability properties. This work will focus on the durability of mass timber from an environmental degradation perspective, looking at the material degradation under weathering.	Discuss funding options with lecturer
Dr Humaira Fataar	MEng [R]/[S]	Timber construction in South Africa	With the increase in sustainable construction practices and materials on the rise globally and in SA, this work will look at the viability of timber as a construction material in SA.	Discuss funding options with lecturer
Dr Humaira Fataar	MEng [R]/[S]	Numerical modelling of intumescent in gaps of mass timber connections in fire	Small gaps occur as a result of construction tolerances in mass timber connections. According to the Fire Design Specification for Wood Construction, gaps larger than 3 mm are assumed to be fully exposed to fire and therefore influences the fire resistance rating of the connection. This research develops a numerical model simulating the intumescent passive protection in gaps of mass timber connections in fire.	Discuss funding options with lecturer
Prof C Viljoen / Prof NPJ de Koker	MEng[R] / PhD	Target reliabilities for existing structures	Because maintenance is associated with a significantly different cost profile than new structures, a separate target reliability value for maintenance must be determined to avoid overdesigned maintenance or retrofitting solutions. This target reliability value is needed to calibrate partial safety factors used in designing retrofitting and maintenance solutions. This project will aim to interpret and adapt currently available literature on target reliability for existing structures for use in maintenance planning of typical SA bridges. Establish the links that may allow available bridge condition data to inform the choice of input parameters including partial factors for assessment.	Speak to lecturer for funding options

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Prof NPJ de Koker / Prof C Viljoen	MEng[R] / PhD	Time-dependent reliability of reinforced concrete structures due to material deterioration	Modern structural design codes are calibrated to target reliability values (safety levels). With the course of time as a structure is exposed to various environmental and loading factors, the concrete and reinforcing steel will decay and corrode, resulting in a systematic reduction in structural capacity. The structural reliability will decay along with the capacity, and once a critical minimum safety level is reached, maintenance work should be performed to return the structure to a more acceptable reliability value. Determining the service life from the perspective of reliability requires a description of the systematic decay in reliability in response to material deterioration. This project will aim to interpret and adapt currently available literature on material decay to obtain a practical description of time-dependent reliability of structures in a South African context.	Speak to lecturer for funding options
Prof NPJ de Koker	MEng[R] / PhD	Open topic in materials modeling and uncertainty quatification	Details of the project can be developed based on the intersection of interests between student and supervisor.	Speak to lecturer for funding options
Prof NPJ de Koker / Dr PJ Kruger	MEng[R] / PhD	In-situ monitoring for digital twin representation in modular 3D concrete printing	Combine in-situ monitoring during 3D concrete printing with data analysis and 3D visualisation to construct an as-built digital twin for a modular 3DCP unit.	Speak to lecturer for funding options
Prof AJ Babafemi	MEng[R] / PhD	Sustainable high-volume fly ash-based concrete from seawater, recycled aggregate and fibre	Develop and test concrete produced from high-volume fly ash, seawater, recycled aggregate and fibre. Fresh, mechanical and durability properties are to be tested. Also, LCA/LCCA will be conducted for the optimum mix.	Speak to lecturer for funding options
Prof AJ Babafemi	PhD	3D printable sustainable high-volume fly ash & calcined clay-based concrete from seawater and recycled aggregate and fibre	Development of 3D printable sustainable concrete from fly ash and calcined clay, seawater, waste plastic (RESIN8C) incorporated as fine aggregate and recycled fibre. LCA/LCCA will be conducted.	Speak to lecturer for funding options
Prof AJ Babafemi	MEng[R] / PhD	Fresh, rheological and hardened mechanical investigation of limestone calcined clay 3D printed geopolymer concrete (LC2-3DPGPC)	Develop a 3D printable geopolymer mix using limestone calcined clay (LC2) as the precursor. Green alkali reactants to be developed and used. LCA/LCCA will be conducted.	Speak to lecturer for funding options
Prof AJ Babafemi	MEng[R] / PhD	Thermal and durability testing and sustainabilityanalysis of LC2-3DPGPC	Conduct thermal and durability testing of LC2-3DPGPC, including sustainability analysis.	Speak to lecturer for funding options
Prof AJ Babafemi	MEng[R]	Platimum slag as fine aggregate in concrete for coastal application	Subtitute platinum slag as fine aggregate in concrete and test mechanical and durability properties.	Funding available
Prof John Babafemi / Prof Riaan Combrinck	MEng [R]/PhD	Metakaolin concrete	This study will investigate the optimal content of metakaolin that can be used with the various types of cement available in the SA market for normal strength and high strength concrete. The compatibility of metakaolin with different chemical admixtures will also be investigated. The fresh, mechanical, and durability properties, including shrinkage tests will be performed.	Speak to lecturer for funding options
Prof John Babafemi / Prof Riaan Combrinck	MEng [R]/PhD	Alternatives to steel reinforcement of concrete	This study will investigate several alternatives to steel reinforcement of concrete. Steel manufacturing has a large carbon footprint and the inclusion of steel in concrete is responsible for the majority of durability issues in reinforced concrete structures. This study will consider alternative reinforcement options such as FRP, carbon and bamboo. The performance of these reinforcement option will be compared to steel.	Speak to lecturer for funding options