List of PhD Project Proposals Academic Year 2010-11

Title	**ADVANCED COMPOSITES AS REINFORCEMENT FOR CONCRETE**
Supervisors	Prof Kypros Pilakoutas, Dr Maurizio Guadagnini
Description	The Construction Innovation Research Group has been working in the field of FRP reinforcement for over 15 years and participated in many large research topics spanning most areas in the field. Research topics include: Bond Shear Design Philosophy Durability Design applications Depending on the project this may be an experimental or analytical project or both. There are strong links with industry, which is normally directly involved in these projects.
Joint Supervisor	Dr Kyriacos Neocleous
Pre-requisite Qualifications:	MEng , MSc (First class or Distinction)
Website:	http://www.shef.ac.uk/ci/research/frp/index.html
Research Group	Concrete and Earthquake Engineering

Title	**ADVANCED COMPOSITES FOR STRUCTURAL STRENGTHENING**
Supervisor	Prof Kypros Pilakoutas, Dr Maurizio Guadagnini
Description	The Construction Innovation Research Group has been working in the field of FRP reinforcement for over 15 years and participated in many large research topics spanning most areas in the field. Research topics include: Plate bonding of RC Steel and other structures Wrapping of Columns Strengthening of special structures Seismic Strengthening Depending on the project this may be an experimental or analytical project or both. There are strong links with industry, which is normally directly involved in these projects
Joint Supervisor	Dr Kyriacos Neocleous
Pre-requisite Qualifications:	MEng , MSc in Concrete or Structural Engineering (First class or Distinction)

Website:	http://www.shef.ac.uk/ci/research/frp/index.html
Research Group	Concrete and Earthquake Engineering

Title	**COMMERCIALISATION OF CONSTRUCTION INNOVATION**
Supervisor	Prof Kypros Pilakoutas, Dr Maurizio Guadagnini
Description	The process of getting construction innovation from research to practice. Topics include: Innovative Flexural Reinforcements FRP reinforcement Innovative FRC elements Couplers Permanent Formwork Concrete Fixings Expansion joints New Materials in Construction
Joint Supervisor	Dr Kyriacos Neocleous
Pre-requisite Qualifications:	MEng , MSc (First class or Distinction)
Website:	http://www.shef.ac.uk/ci/
Research Group	Concrete and Earthquake Engineering

Title	**EARTHQUAKE RESISTANT DESIGN OF REINFORCED CONCRETE STRUCTURES**
Supervisor	Prof Kypros Pilakoutas, Dr Maurizio Guadagnini
Description	Projects include: Ductility design Special Energy Dissipation Systems Non-Linear dynamic analysis Concrete ductility Depending on the project this may be an experimental or analytical project or both. There are strong links with industry, which is normally directly involved in these projects.
Joint Supervisor	Dr Mihail Petkovski, Dr Kyriacos Neocleous
Pre-requisite Qualifications:	MEng , MSc in Structural or Earthquake Engineering (First class or Distinction)
Website:	http://www.shef.ac.uk/ci/research/earthquake
Research Group	Structural dynamics and vibrations

Title	**EARTHQUAKE RISK ASSESSMENT AND MANAGEMENT**
Supervisor	Prof Kypros Pilakoutas, Dr Maurizio Guadagnini
Description	Projects likely: Vulnerability of Constructions in the Southern Europe Earthquake Mitigation Studies Risk Assessment and Management Seismic Strengthening
Joint Supervisor	Dr Kyriacos Neocleous
Pre-requisite Qualifications:	MEng , MSc in Structural or Earthquake Engineering (First class or Distinction)
Website:	http://www.shef.ac.uk/ci/research/earthquake
Research Group	Structural dynamics and vibrations

Title	**FRAMEWORK FOR THE TESTING AND MODELLING OF FREEZE-THAW AND CORROSION RESISTANCE OF STEEL FIBRE REINFORCED CONCRETE PAVEMENTS**
Supervisor	Prof Kypros Pilakoutas
Description	Steel fibre reinforced concrete (SFRC) has enhanced mechanical properties when compared to plain (i.e. unreinforced) concrete. However, the durability of SFRC is not well known, especially when considering its freeze-thaw resistance. Similarly to plain concrete, the air-void system of SFRC is the main factor affecting its freeze-thaw resistance; however, there is no clear evidence on the effect of steel fibres on the freeze-thaw resistance of concrete, and further experimental and theoretical investigations are required. Furthermore, the combined effect of freeze-thaw and corrosion on the mechanical properties of SFRC should be investigated, since SFRC is often used for the construction of rigid pavements, exposed to freeze-thaw cycles and de-icing salts. The main aim of this research is to develop a framework for the experimental and theoretical modelling of SFRC, exposed to combined freeze-thaw and corrosive environments. This research includes both experimental and theoretical research.
Joint Supervisor	Dr Terry Bennett, Dr Kyriacos Neocleous
Pre-requisite Qualifications:	MEng , MSc (First class or Distinction)
Website:	http://www.shef.ac.uk/ci/research/frc/index.html
Research Group	Concrete and Earthquake Engineering

Title	**FRC - FIBER REINFORCED CONCRETE**
Supervisor	Prof Kypros Pilakoutas, Dr Maurizio Guadagnini
Description	A number of research projects are already running in this field. Likely projects: The use of Glass FRC in thin concrete structures The use of steel fibres in concrete The mixed use of fibres in concrete Depending on the project this may be an experimental or analytical project or both. There are strong links with industry, which is normally directly involved in these projects.
Joint Supervisor	Dr Kyriacos Neocleous
Pre-requisite Qualifications:	MEng , MSc (First class or Distinction)
Website:	http://www.shef.ac.uk/ci/
Research Group	Concrete and Earthquake Engineering

Title	**LONG-TERM DESIGN AND SAFETY PHILOSOPHY FOR REINFORCED CONCRETE**
Supervisor	Prof Kypros Pilakoutas, Dr Maurizio Guadagnini
Description	The design and safety philosophy of current codes of practice for reinforced concrete (RC) structures is based on the semi probabilistic format of partial safety factors. Past research has indicated that the application of this design and safety philosophy leads to a number of issues, such as variable structural reliability levels and predominant mode of failure is not known a priori. Additional issues arise when considering the long-term behaviour of RC structures, since the current safety format does not seem to account directly for it, especially the effect of aggressive environments on the mechanical behaviour of RC. The main aim of this research is to develop a safety and design philosophy that accounts for the long-term behaviour of RC structures. This will require use of structural reliability theory as well as uncertainty modelling and will be co-supervised by Dr Kyriacos Neocleous (k.neocleous@sheffield.ac.uk).
Joint Supervisor	Dr Kyriacos Neocleous
Pre-requisite Qualifications:	MEng , MSc (First class or Distinction)
Website:	http://www.shef.ac.uk/ci/research
Research Group	Concrete and Earthquake Engineering

Title	**MECHANICAL BEHAVIOUR AND DURABILITY OF STEEL FIBRE-REINFORCED ROLLER-COMPACTED CONCRETE MADE WITH RECYCLED MATERIALS**
Supervisor	Prof Kypros Pilakoutas, Dr Maurizio Guadagnini
Description	Roller-compacted concrete (RCC) is made from the combination of aggregates, water and binder and is mostly used for the construction of rigid pavements. Although the same ingredients as for wet-consistency concrete are used, these are mixed at different proportions resulting to a material with special properties and behaviour, which has a consistency representative of zero slump concrete. Previous research has demonstrated that RCC can be reinforced successfully with steel fibres to improve its post-cracking properties and result in more economical and sustainable rigid pavements. However, to improve further the sustainability of steel fibre-reinforced (SFR) RCC pavements, it is necessary to maximise the use of recycled materials (such as recycled aggregates and steel tyre-cord fibres) in the concrete mix. The main aim of this research will therefore be to develop SFR-RCC mixes made with 100% recycled materials and examine their mechanical behaviour and durability to a number of environments (namely corrosion and freeze-thaw). This research will be co-supervised by Dr Kyriacos Neocleous (k.neocleous@sheffield.ac.uk) and will include both experimental and theoretical research and utilise the findings of the FP6 STREP project "EcoLanes" (http://ecolanes.shef.ac.uk).
Joint Supervisor	Dr Kyriacos Neocleous
Pre-requisite Qualifications:	MEng , MSc (First class or Distinction)
Website:	http://www.shef.ac.uk/ci/research/frc/index.html
Research Group	Concrete and Earthquake Engineering

Title	**MODELLING OF SHRINKAGE EFFECTS ON THE MECHANICAL PROPERTIES OF CONCRETE**
Supervisor	Prof Kypros Pilakoutas, Dr Maurizio Guadagnini
Description	Concrete shrinkage is a result of cement hydration and is influenced by endogenous factors, such as the mix design and types of materials, as well as exogenous factors, such as environmental conditions. Exogenous factors which include, temperature, wind, humidity, type of curing and type of formwork/restrain, can have an adverse impact on shrinkage, leading to large cracks and loss of tensile strength. Cracking and loss of tensile strength can be critical in some structures, such as water retaining structures and load bearing pavements, and will affect adversely the durability of most structures, especially ones exposed to salt (such as in Barbados). However, it is known that concrete has some self-healing properties, which means that small cracks may close, due to continuous hydration under the right conditions. The effect of self-healing on the strength of cracked

concrete is currently not known.

The design of concrete structures and pavements is currently undertaken by ignoring the combined effect of thermal loads, shrinkage and load on the mechanical properties of concrete, such as tensile strength. This can lead to serviceability and structural failures in certain structures, in particular load bearing pavements.

The aim of the proposed research is to investigate both theoretically and experimentally the effect of shrinkage on the tensile behaviour of concrete. The study will consider a range of concrete mixes, including those reinforced with steel fibres (both primary and recycled). The project will attempt to develop for the first time constitutive models that can deal with the effect of crack healing. The impact of self healing on the design of structures will be assessed and recommendations for design will be made.

Joint Supervisor	Dr Kyriacos Neocleous
Pre-requisite Qualifications:	MEng , MSc (First class or Distinction)
Website:	**http://www.shef.ac.uk/ci/research/frc/index.html**
Research Group	**Concrete and Earthquake Engineering**
Title	**NOVEL PUNCHING SHEAR REINFORCEMENT**
Supervisor	Prof Kypros Pilakoutas, Dr Maurizio Guadagnini
Description	The supervisor had developed a novel system for punching shear reinforcement called the Shearband and now LSF. Projects likely in this field: Bond characteristics of special shear reinforcement systems Seismic resistance of the LSF Development of robust models for punching shear resistance Depending on the project this may be an experimental or analytical project or both. There are strong links with industry, which is normally directly involved in these projects.
Joint Supervisor	Dr Kyriacos Neocleous
Pre-requisite Qualifications:	MEng , MSc (First class or Distinction)
Website:	http://www.erico.com/products/steelfortress.asp
Research Group	Concrete and Earthquake Engineering

Title	**POST-CRACKING MODELLING OF FIBRE REINFORCED CONCRETE**
Supervisor	Prof Kypros Pilakoutas, Dr Maurizio Guadagnini
Description	Plain (i.e. unreinforced) concrete has low tensile strength, limited ductility and low crack resistance. The need to improve these weak properties has led to the development of fibre reinforced concrete (FRC), which has enhanced post-cracking characteristics. Although direct tensile tests can be undertaken to evaluate empirically the post-cracking tensile characteristics of FRC, the flexural test is widely used, as it is an easier test to conduct. Fracture mechanics theory and/ or stress-strain relationships can be used together with empirical flexural data to model the FRC's tensile characteristics. However, the developed theoretical models are often inaccurate as they do not account for important parameters, such as the size effect of FRC as well as the dimensions of FRC's fracture process zone. As a result, the developed models cannot be used effectively by the construction industry, as they require additional testing when considering the behaviour of new types of FRC. The main aim of this research is to develop a simplified framework for modelling the tensile characteristics of FRC. This research will be co-supervised by Dr Kyriacos Neocleous (k.neocleous@sheffield.ac.uk) and will include both experimental and theoretical research.
Joint Supervisor	Dr Terry Bennett, Dr Kyriacos Neocleous
Pre-requisite Qualifications:	MEng , MSc (First class or Distinction)
Website:	http://www.shef.ac.uk/ci/research/frc/index.html
Research Group	Concrete and Earthquake Engineering

Title	**SEISMIC STRENGTHENING OF RC USING EXTERNAL LATERAL POST-TENSIONING**
Supervisor	Prof Kypros Pilakoutas, Dr Maurizio Guadagnini
Description	A simple technique developed and patented by the University of Sheffield utilises metallic strips to repair and strengthen RC elements damaged by blast or earthquakes. The project will investigate this technique for experimentally and analytically and develop models for its application in vulnerable buildings.
Joint Supervisor	Dr Kyriacos Neocleous
Pre-requisite Qualifications:	MEng , MSc in Structural or Earthquake Engineering(First class or Distinction)
Website:	http://www.shef.ac.uk/ci/
Research Group	Structural dynamics and vibrations

Title	**STRUCTURAL ANALYSIS AND DESIGN OF STEEL FIBRE REINFORCED CONCRETE PAVEMENTS FOR SURFACE TRANSPORT.**
Supervisor	Prof Kypros Pilakoutas, Dr Maurizio Guadagnini
Description	Roller-compacted concrete (RCC) is made from the combination of aggregates, water and binder and is mostly used for the construction of rigid pavements. Although the same ingredients as for wet-consistency concrete are used, these are mixed at different proportions resulting to a material with special properties and behaviour, which has a consistency representative of zero slump concrete. Previous research has demonstrated that RCC can be reinforced successfully with steel fibres to enhance its post-cracking properties. To promote the use of steel fibre-reinforced (SFR) RCC in surface transport pavement construction, it is necessary to develop analysis and design tools, which could be used effectively by the construction industry. The main aim of this research will be to develop a framework for the analysis and design of SFR-RCC pavements, which accounts for the inelastic properties of SFR-RCC. The framework should consider the latest developments on the empirical-mechanistic design of pavements and utilise experimental data obtained from the accelerated load testing of SFR-RCC pavement sectors, undertaken as part of the FP6 STREP project "EcoLanes" (http://ecolanes.shef.ac.uk).
Joint Supervisor	Dr Terry Bennett, Dr Kyriacos Neocleous
Pre-requisite Qualifications:	MEng , MSc (First class or Distinction)
Website:	http://www.shef.ac.uk/ci/research/frc/index.html
Research Group	Concrete and Earthquake Engineering

Title	**THE BEHAVIOUR AND DESIGN OF REINFORCED CONCRETE STRUCTURES**
Supervisor	Prof Kypros Pilakoutas, Dr Maurizio Guadagnini
Description	Projects in any of the main aspects of RC: Shear Punching shear Flexural Behaviour Bond Ductility
Joint Supervisor	Dr Kyriacos Neocleous
Pre-requisite Qualifications:	MEng , MSc in Concrete or Structural Engineering (First class or Distinction)
Website:	http://www.shef.ac.uk/ci/
Research Group	Concrete and Earthquake Engineering

Title	**UNCERTAINTY MODELLING AND STRUCTURAL RELIABILITY ASSESSMENT OF REINFORCED CONCRETE.**
Supervisor	Prof Kypros Pilakoutas, Dr Maurizio Guadagnini
Description	Structural reliability assessment is an effective tool for assessing the structural uncertainty of reinforced concrete (RC) and developing partial safety factor that can be used in the codified design of RC structures. Various theories, such as direct probability theory, fuzzy logic and set theory, can be used to assess the structural reliability; however there is no consensus on which theory is the most appropriate. The aim of this research is to evaluate the various theories that can be employed for uncertainty modelling and structural reliability assessment of RC and develop a simplified but yet accurate framework than can be easily adopted by code committees for the determination of partial safety factors. This research will be co-supervised by Dr Kyriacos Neocleous (k.neocleous@sheffield.ac.uk).
Joint Supervisor	Dr Kyriacos Neocleous
Pre-requisite Qualifications:	MEng , MSc (First class or Distinction)
Website:	http://www.shef.ac.uk/ci/research
Research Group	Concrete and Earthquake Engineering

Title	**USE OF RECYCLED MATERIALS IN CONCRETE**
Supervisor	Prof Kypros Pilakoutas, Dr Maurizio Guadagnini
Description	A number of research projects are already running in this field. Likely projects: The use of recycled steel fibres in concrete The use of waste plastic in concrete The use of Glass in concrete Depending on the project this may be an experimental or analytical project or both. There are strong links with industry, which is normally directly involved in these projects.
Joint Supervisor	Dr Kyriacos Neocleous
Pre-requisite Qualifications:	MEng , MSc (First class or Distinction)
Website:	http://www.shef.ac.uk/tyre-recycling/index.htm
Research Group	Concrete and Earthquake Engineering