The construction industry needs creative and innovative graduates who can solve problems and exercise leadership.

At Stellenbosch University the Chair for Construction Engineering and Management (CEM) prepares professionals for the planning, implementation and maintenance of multi-disciplinary engineering projects such as infrastructure, industrial, process, power and building projects. The Chair stimulates innovation and creative thinking, whilst promoting best management practice for the successful implementation of major capital works.

The CEM academic programme supports the leadership pipeline at various levels through its delivery of practical, industry-related courses and post-graduate research work. Under-graduate students are introduced to the construction industry and its challenges, as well as the concepts of construction management and engineering economy.

Although the Chair participates in the curriculum of the final year of under graduate studies in civil engineering, the focus is on post graduate programmes. Students can enrol for MEng(research), MEng(structured) and PhD studies. Students with backgrounds and qualifications other than BEng and BScEng are also encouraged to participate and can be considered for the Postgraduate Diploma in Engineering (PDE).
Courses offered in the post graduate programme are a compilation of modules from the Department of Civil Engineering, Department of Industrial Engineering and other departments at Stellenbosch University. Course topics are structured to provide for management skills to be developed amongst all participants in the project cycle. In order to maintain close collaboration with industry, and to support continuous professional development, industry participants are able to attend modules of the post graduate curriculum.

The annual CMP (Construction Management Program) which is supported by the Chair develops high level management skills amongst experienced industry practitioners. It is a four week intensive course with national and international faculty, and aims to stimulate debate, innovation and creativity in the industry.

Research is an essential part of the learning process towards scientific and investigative thinking. This is performed as part of the post graduate programme and is focused around central themes in order to build a capacity and expertise for the department in specific fields. The research at the Chair for Construction Engineering and Management aims to address the needs of the industry by performing research relevant to the construction environment which would allow improved processes, management and quality. The Chair focuses on multi disciplinary capital projects. Areas of particular interests are design management, project risk, modular construction and infrastructure asset management. Students are however encouraged to suggest their own topics which can be tailored to suit the general research themes.

The language of instruction in postgraduate studies is in line with the strategic framework of the University to be language-friendly. Courses are taught in English to accommodate international participation in the post graduate program.

Information about course schedules can be found at www.civeng.sun.ac.za. A Post Graduate Brochure of the Department of Civil Engineering with information on post graduate studies, including admission requirements can also be downloaded from this web site.

The Chair has limited bursaries available for full time studies towards the MEng(research) degree. Applications for 2016 must be submitted before 15 October 2015. For more information about course content, requirements and bursaries contact Mrs Hesmarie Bosman (hesmarieb@sun.ac.za).

THE ENVIRONMENT OF CONSTRUCTION ENGINEERING AND MANAGEMENT

![Diagram showing the roles of Client, Consultant, User, Contractor, and PROJECT]

THE ENVIRONMENT OF CONSTRUCTION ENGINEERING AND MANAGEMENT
<table>
<thead>
<tr>
<th>Courses</th>
<th>Client/Consultant</th>
<th>Contractor</th>
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<td>Project Management</td>
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<td>Management Fundamentals</td>
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<td>Technology Management</td>
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<td>Project procurement and PPP</td>
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<td>Construction risk management</td>
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<td>Construction management</td>
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<td>Infrastructure asset management</td>
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Introduction

Research at the Chair in Construction Engineering and Management focuses on the fields described below. The ultimate 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, risk management, identification of hurdles and shortcomings, through to management of large projects.

Modular Construction:

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.

Investigations identified that, although several projects in South Africa have successfully made use of prefabrication, several others have been less successful. This identified a general shortcoming in management capabilities, quality of workmanship and lack of skills, all items which need extensive attention to improve the efficiency of the construction industry as a whole.

Three components of modular construction are considered:

- Technical aspects: these include design methods and standards, connection layout, connection concepts, design, and interface conditions for (and due to) shear, shrinkage and creep. It also includes the use of new developments in materials such as fibre reinforced concrete, self compacting concrete and high strength concrete.
- Managerial aspects: these include managerial skills required for the project execution, but also management of the collaboration between designers, contractors and owners.
- Contractual aspects: a decision to use pre-fabrication on a project needs to be identified at an early stage in the project. The conceptual design needs to allow for such an approach, and the contractual arrangements need to facilitate such early collaboration. Procurement methods need to be reconsidered to enable more effective exploitation of the advantages of pre-cast construction.

Infrastructure asset management

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.

New models are required through which the necessary skills can be developed through accelerated learning processes. Creative solutions are required to involve the community in infrastructure maintenance, and national support is required in the form of knowledge centres.

Research is directed to address these items in the South African context. Lessons learned in South Africa will be applicable to other developing countries, and is an essential stepping stone towards economic growth in developing countries.

The Construction Management Program (CMP) is well positioned to develop managerial skills at middle management level to enable a more effective management and procurement of infrastructure in South Africa.
Construction Risk Management

All projects are subject to risks, and these can range from risks for the client, consultant and contractor.

Often risks are created by one project participant, which have an influence on the risks experienced by other project participants. 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.

Development of risk management practices also has the benefit of allowing project participants to think creatively about the project. This thinking process is one of the essential skills which need to be developed, and which was identified as one of the principle outcomes expected from a program in Construction Engineering and Management.

Design Management

Project participants have a tendency to work in isolation, focusing on their areas of expertise and specialization. It often occurs that designs are not considered to be practical, economical or constructable. There is a clear need for contractors and designers to collaborate more extensively in the project design process.

Normally, each party (designer and contractor) have their own priorities for project concept and details, based on their perspective, experience and contractual position. This leads to projects which cost more than what they should, wasting valuable finances and time. Ideally, a dedicated design management process is needed (not only on large projects) which can drive the design process, by taking into account construction requirements, preferences, experience and knowledge.

Procedures to direct this process 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

Large projects often have a tendency to exceed the anticipated project cost and duration. This may be related to a variety of factors, which may include the experience of project participants in making cost estimates by not allowing for all the different aspects of the project, it may include a project scope which is beyond the experience of the planners. It may also be related to scope changes and economical conditions. Several others factors play a role in possible cost and time overruns.

The research aims to investigate these factors with the aim of improvement of project delivery.