ENGINEERING COUNCIL OF SOUTH AFRICA *Standards and Procedures System*			
Discipline-specific Training Guideline for Candidate Engineers in Civil Engineering			
Status: Approved by Registration Committee for Professional Engineers			
Document : R-05-CIV-PE	**Rev-1**	**12 March 2013**	

Background: ECSA Registration System Documents

The documents that define the Engineering Council of South Africa (ECSA) system for registration in professional categories are shown in Figure 1 which also locates the current document.

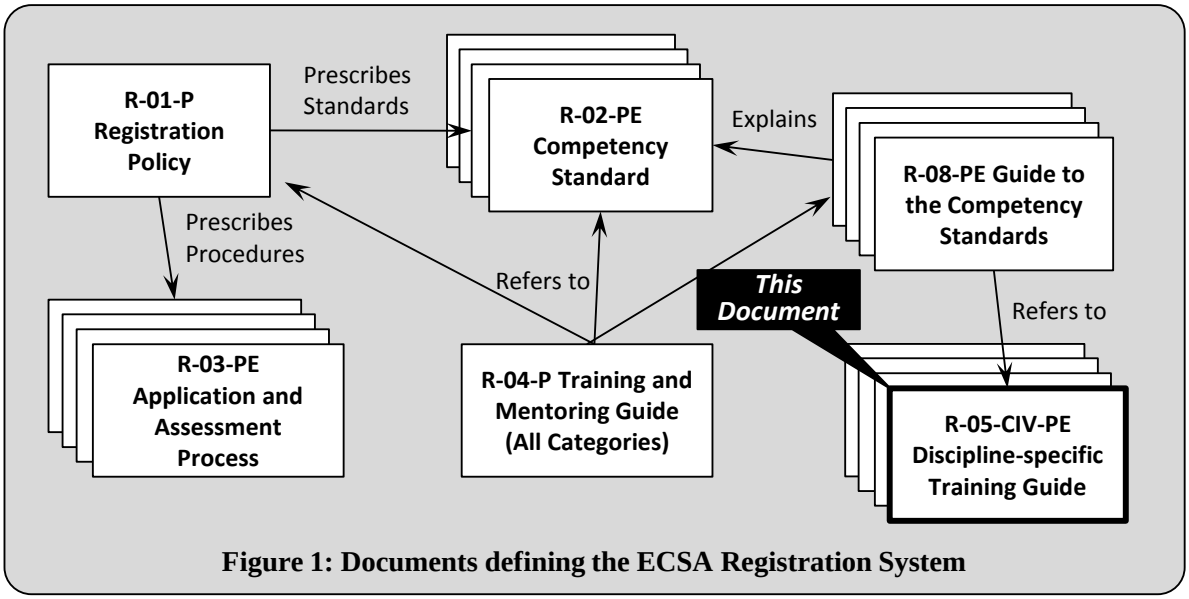

Figure 1: Documents defining the ECSA Registration System

1. Purpose

All persons applying for registration as Professional Engineers are expected to demonstrate the competencies specified in document R-02-PE at the prescribed level, irrespective of the trainee's discipline, though work performed by the applicant at the prescribed level of responsibility.

This document supplements the generic *Training and Mentoring Guide* R-04-P and *the Guide to the Competency Standards for Professional Engineers*, document R-08-PE.

In document R-04-P attention is drawn to the following sections:

- 7.3.2 Duration of training and period working at level required for registration
- 7.3.3 Principles of planning training and experience
- 7.3.4 Progression of Training programme
- 7.3.5 Documenting Training and Experience
- 7.4 Demonstrating responsibility

The second document R-08-P provides both a high-level and outcome-by-outcome understanding of the competency standards as an essential basis for this discipline specific training guide.

This Guide, as well as R-04-P and R-08-PE, are subordinate to the Policy on Registration, document R-01-P, the Competency Standard (R-02-PE) and the application process definition (R-03-PE).

2. Audience

This Guide is directed to candidates and their supervisors and mentors in the discipline of Civil Engineering. The Guide is intended to support a programme of training and experience incorporating good practice elements.

This guide applies to persons who have:

1. Completed the education requirements by obtaining an accredited BEng-type qualification, or a Washington-Accord Recognised qualification or through evaluation/assessment;
2. Registered as Candidate Engineers;
3. Embarked on a process of acceptable training under a registered Commitment and Undertaking (C&U) with a Mentor guiding the professional development process at each stage.

3. Persons not Registered as a Candidate or not Training under a C&U

All applicants for registration must present the same evidence of competence and be assessed against the same standards, irrespective of the development path followed. Application for registration as a Professional Engineer is permitted without being registered as a Candidate Engineer or without training under a C&U. Mentorship and adequate supervision are however key factors in effective development to the level required for registration. A C&U indicates that the company is committed to mentorship and supervision.

If the trainee's employer has no C&U, the trainee should establish the level of mentorship and supervision the employer is able to provide. In the absence of an internal mentor, the services of an external mentor should be secured. The Voluntary Association for the discipline should be consulted for assistance in locating an external mentor. A mentor should be in place at all stages of the development process.

This guide is written for the recent graduate who is training and gaining experience toward registration. Mature applicants for registration may apply the guide retrospectively to identify possible gaps in their development.

Any applicants who have not enjoyed mentorship are advised to request an experienced mentor (internal or external) to act as an application adviser while they prepare their application for registration.

The guide may be applied in the case of a person moving into a candidacy programme at a later stage that is at a level below that required for registration (see section 7.3).

4. Civil Engineering

Civil Engineers (OFO 2142)

A *Civil Engineer* plans, designs, organises and oversees the construction and operation of civil engineering projects such as:

Structural: buildings, dams, bridges, roads, highways, runways, harbours, railways;
Geotechnical: township services earthworks, excavations, soil conservation and geotechnical processes;
Transportation systems;
Hydraulic Engineering systems: water resources and supply, pipelines, canals, water treatment, stormwater and drainage, sewerage systems; sanitation waste disposal, coastal engineering.

Typical Tasks that a *Civil Engineer* may undertake include:

- Conducting research and developing new or improved theories and methods related to civil engineering
- Advising on and designing infrastructure such as bridges, dams, harbours, roads, airports, railways, canals, pipelines, treatment works, waste-disposal and flood-control systems, and residential, commercial, industrial and other large buildings
- Determining and specifying construction methods, materials and quality standards and directing construction work
- Establishing control systems to ensure efficient functioning of infrastructure as well as safety and environmental protection
- Organising and directing maintenance and repair of existing civil engineering infrastructure
- Analyzing the behaviour of soil and rock when placed under pressure by proposed structures and designing structural foundations
- Analyzing the stability of structures and testing the behaviour and durability of materials used in their construction

Practising *Civil Engineers* generally concentrate in one or more of the following areas:

- Structural Engineering
- Geotechnical Engineering
- Hydraulics Engineering and Water Resources and Supply
- Construction Engineering including Site Design
- Transport Engineering

More specialised Civil Engineers may be in fields such as: Transportation and Urban Planning; Biosystems Engineering, GIS and Landuse Management.

5. Training Implications of the Nature and Organisation of the Industry

Civil engineers may be employed in both the private and public sector.

Typically in the private sector they would be involved in consulting, contracting, or in supplier or manufacturing organisations. Consultants are responsible for planning, designing, documenting, and supervising the construction of projects on behalf of their clients. Contractors are responsible for project implementation and activities include planning, construction, labour and resource management. Those working in supply or manufacturing companies could be involved in research and development, and would be involved in production, supply and quality control.

The public sector is responsible for service delivery and is usually the client, though in some departments design and construction is also carried out. Civil engineers are required at all levels of the public sector, including at national, provincial and local government level, state owned enterprises (SOEs), and public utilities. The public sector largely handles planning, specifying, overseeing implementation, operations and maintenance of infrastructure.

An extension of the public sector would include tertiary academic institutions and research organisations.

Depending on where the candidate is employed, there may be situations where the opportunuties in-house are not sufficiently diverse to develop all the competencies required in both Groups A and B noted in document R-02-PE. For example the opportunity for developing problem solving competence (including design or developing solutions) and for managing engineering activities (including implementing or constructing solutions) may not both be available to the candidate. In such cases employers are encouraged to put a secondment system in place.

It has been fairly common practice that where an organisation is not able to provide training in certain areas that secondments are arranged with other organisations, so that the candidate is able develop all the competencies required for registration.

These secondments are usually of a reciprocal nature so both employers and their respective employees get the mutual benefit from the other party. Secondments between consultants and contractors, and between the public and private sector should be possible.

6. Developing competency: Elaborating on sections in the Guide to the Competency Standards, document R-08-PE

6.1 Engineering Lifecycle Considerations.

The civil engineer is involved in activities associated with the asset life cycle as shown in Figure 1.

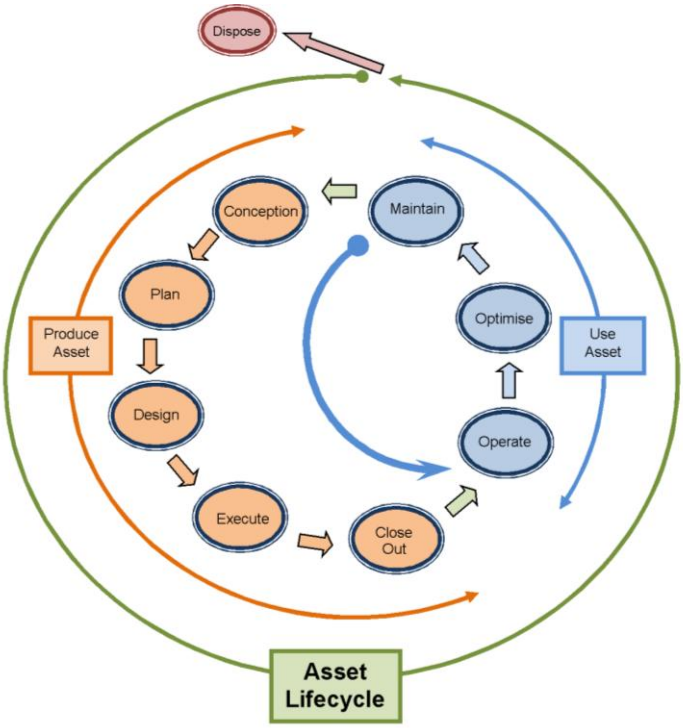

Figure 1: Asset Lifecycle

6.2 Functions Performed

A conventional path to registration will usually involve the candidate carrying out the functions described in Table 1.

Generally these functions, as described in the Asset Lifecycle above, would be related to the "producing an asset" portion, but could also relate to the "use of an asset" portion.

In the case of "producing an asset", the functions are expanded from the conventional sequence of an engineering project; conceive, design, implement, and operate, and usually the candidate will experience them in this order.

In the case of "use of an asset", where the work involves operations and maintenance, the candidate may experience them differently, but the functions may be similar.

Table 1: Functions

1.	**ORIENTATION**
	Be exposed to, observe and understand a range of processes, material and products that are relevant to your employer and typical clients.
2	**DEVELOPING AN ENGINEERING BRIEF**
2.1	**Accurate identification and definition:** Take an active part, probably in a supporting role, in researching, compiling and assessing basic data, background information and the meaning and purpose of an assignment. Record your involvement in a report to your mentor and demonstrate the process by which the assignment was finally and properly defined.
2.2	**Systems Approach** It is generally accepted that to ensure a holistic (all encompassing) solution to a problem, all relevant aspects are to be taken into account. In reports to your mentor, record how, out of your own experience, you were involved in adopting the wider approach in defining problems.
2.3	**Standards and Codes** List the National and International standards, Codes of Practice, Environmental Requirements documents you have used. Discuss their relevance to your work in your reports to your mentor.
3	**DESIGNING A SOLUTION**
3.1	**Resolution of an engineering brief** This will involve compiling all relevant data acquired during the investigation period and a statement of the analytical work completed. Finding Alternative Solutions This will involve the technical and financial evaluation of alternatives by, for example, assisting with a feasibility study covering aspects such as: • Concepts and precedents • Sources of information • Estimates and budget quotations • Quick design methods • Writing, production and interpretation of feasibility reports • Briefs for detail design In a report to your mentor produce your preferred solution, with justification, showing throughout (or by an accompanying statement) how this work contributed to the solution of the problem and identify the major factors on which the solution depended for accuracy or completeness.
3.2	**Present the solution to a problem** This will involve producing documentation on the solution including diagrams, charts and/or detailed drawings using acceptable standards. In a report to your mentor present the example for discussion and approval.
3.3	**Choice of construction material when deciding on a solution** Read supplier's instructions for use of patent materials. Read SABS specifications on civil engineering materials (naturally occurring processed and manufactured). List all references. Discuss the choice and use of prescribed materials for a specific solution with your mentor.

Table 1: Continued

4	**DOCUMENTATION**
4.1	**Purpose of Documentation** This involves acquiring an appreciation that technical specifications are an essential part of a solution to the problem. Select or write a specification and/or amend an existing specification for a particular item of work. Discuss a specification used in your work with your mentor.
4.2	**Costing of solutions** Cost solutions to problems by taking off quantities and doing cost estimates. Present examples to the mentor for discussion and comment.
4.3	**Safety** State in a quarterly report which regulations apply and what safety criteria you have followed in the course of implementing solutions.
5	**IMPLEMENTATION**
5.1	**Know how all parties to a contract exercise their duties and responsibilities** In a report to your mentor, demonstrate your knowledge of the duties and responsibilities of all parties to a contract and discuss the practical application of the various documents forming a particular contract, with your mentor.
5.2	**Know the procedure for the issuing and/or receipt, registration and filing work instructions and/or drawings and amendments** Gain practical experience of these procedures and demonstrate this experience in a report to your mentor.
5.3	**Keep an accurate daily record of events and instructions** Keep an up-to-date, accurate daily diary for inspection by your mentor
5.4	**Read and co-ordinate drawings and/or implement work instructions** by being involved on a day-to-day basis in the process. Demonstrate your competence by the quality of your work and discuss this with your mentor.
5.5	**Participate in the dimensional control and accuracy of the work you are implementing or controlling.** Demonstrate your competence by the quality of your work and discuss this process with your mentor.
5.6	**Know the use, performance and cost of equipment plant and/or labour resource**. Include in a report to your mentor a list of all major items of which you have first-hand knowledge. Discuss your experience with your mentor.
5.7	**Plan and programme section of work and be involved in progress monitoring and reporting**. Discuss programme with your mentor.
5.8	**Measure and record or independently check work done for payment purposes.** Take part in this work for the preparation of checking of Interim Valuations and/or Final Accounts. Demonstrate your involvement to your mentor.
5.9	**Have a critical approach to safety matters in the implementation process and to the observance of safe working practices.** Know your responsibilities relating to safety and be familiar with legislation relating to your particular work. Appreciate good safety practices relevant to your work by reference to your company safety manual. Emphasize your involvement in safety matters in a report to your mentor

6.3 Contextual Knowledge

Candidates are expected to have knowledge of the following topics:

- **General appreciation of engineering procedures applicable to civil engineering**

  Read the information brochures provided by:

  South African Institution of Civil Engineering (SAICE)
  Consulting Engineers South Africa (CESA)
  South African Federation of Civil Engineering Contractors (SAFCEC)

  Discuss the procedures with your mentor at a quarterly interview

- **Show a working knowledge of the SAICE Constitution and By-laws**

  Read all these documents
  Discuss the documents with your mentor at a quarterly interview

- **Relationships between Organisations**

  Display a working knowledge of the roles of and interaction between Organizations such as:
  Engineering Council of South Africa (ECSA)
  SA Institution of Civil Engineering (SAICE)
  Consulting Engineers South Africa (CESA)
  SA Federation of Civil Engineering Contractors (SAFCEC)
  Building Industries Federation South Africa (BIFSA)
  The Construction Industry Development Board (CIDB)

- **Knowledge of General Conditions of Contract**

  Display a working knowledge of GCCs used in civil engineering such as SAICE GCC, FIDIC, NEC:

- **Structure of Organization where candidate is employed**

  Study all available organization charts. Write a report on the management structure of your organization/project team, defining your roles and responsibilities

6.4 Industry-related statutory requirements

Candidates are expected to have a working knowledge of the following Acts:

- Engineering Profession Act, 2000, (Act 46 of 2000), its Rules, specifically the Code of Conduct
- Occupational Health and Safety Act, 1993 (Act No. 85 of 1993), as amended by Act No. 181 of 1993

Candidates may, depending on their area of practice, need to have a working knowledge of the following Acts:

- National Building Regulations and Building Standards Act, 1977 (Act No. 103 of 1977), as amended by Act No. 49 of 1995
- Environment Conservation Act, 1989 (Act No. 73 of 1989), as amended by Act No. 52 of 1994 and Act No. 50 of 2003
- Water Services Act, 1997 (Act No. 108 of 1997), as amended by Act No. 30 of 2004
- National Water Act, 1998 (Act No. 36 of 1998), as amended by Act No. 45 of 1999

There are many Acts, not listed in this document, that may be pertinent in the work functions of the candidate. Candidates will be expected to have some basic knowledge of these Acts where applicable.

6.5 Recommended Formal Learning Activities

Candidates may find many of the following list of formal learning activities, which is by no means extensive, useful in developing their competencies:

Discipline Specific Courses relating to areas of practice
Report Writing
Project Management
Conditions of Contract
Standard Specifications
Preparation of Specifications
Negotiation Skills
Engineering Finance
Risk Analysis
Quality Systems
Occupation Health and Safety
Quality Systems
Environment Impacts

7. Programme Structure and Sequencing

7.1 Best-practice programmes

Generally, no matter the discipline, it is unlikely that the period of training will only be three years, the minimum time required by ECSA. Typically, it will be longer and would be determined amongst others by the availability of functions in the actual work situation.

There is no ideal training programme structure nor a unique sequencing that constitutes best practice.

The training programme for each candidate will depend on the work opportunities available at the time for the employer to assign to the candidate.

Best practice programmes will be those that address the development of the competencies needed for each candidate to be able to successfully register as a professional engineer.

The training programme should be such that the candidate progresses through levels of work capability, which is described in 7.3.4 of R-04-P, such that by the end of the training period, the candidate must perform individually and as a team member at the level of problem solving and engineering activity required for registration and exhibit degree of responsibility E.

Depending on the nature of the work undertaken by an employer, it may be possible to develop a training programme which provides opportunities to the candidate to undertake the work functions described in section 5.2, Table 1. In some cases an employer may only cover some functions described in section 5.2, Table 1. In such cases, the employer and the candidate should make appropriate arrangements as described in section 4.

It is suggested that the candidate works with their mentors to determine appropriate projects to gain exposure to elements of the asset cycle, to ensure that their designs are constructable, operable, and are designed considering life cycle costing and long-term sustainability.

7.2 Considerations for Special Cases

Section 10 of document R-08-PE adequately describes what would be expected of persons whose formative development has not followed a conventional path, for example academics, researchers, and specialists.

The overriding consideration is that, irrespective of the route followed, the applicant must provide evidence of competence against the standard.

7.3 Moving into or between Candidacy Programmes

This Guide assumes that the candidate enters a programme after graduation and continues with the programme until ready to submit an application for registration. It also assumes that the candidate is supervised and mentored by persons who meet the requirements in document R-04-P section 7.2. In the case of a person changing from one candidacy programme to another or moving into a candidacy programme from a less structured environment, it is essential that the following steps be completed:

- The candidate must complete the Training and Experience Summary (TES) and Training and Experience Reports (TER) for the previous programme or unstructured experience. In the latter case it is important to reconstruct the experience as accurately as possible. The TERs must be signed off.
- On entering the new programme, the Mentor and Supervisor should review the candidate's development in the light of the past experience and opportunities and requirements of the new programme and plan at least the next phase of the candidate's programme.

Revision History

Version	Date	Revised/Approved by	Nature of Revision
Rev 0: Concept A	26 Jan 2012		Initial attempt at Civil DSTG
Rev 0: Concept B	6 July 2012		New Draft of template
Rev 0: Concept C	17 Sept 2012		Amended Hay/Lawless
Rev0: Concept D	29 Oct 2012		Standard sections 1-3 inserted
Rev0: Concept E	12 Feb 2013		Minor edit
Rev 1	1 Mar 2013	Registration Committee for Professional Engineers	