ENSURING THE
EXPERTISE TO GROW
SOUTH AFRICA

Feasibility Study Report for New ECSA Registration Category: Rational Design (Fire Specialist)

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ECSA

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1. INTRODUCTION

The purpose of this report is to motivate for the feasibility of a new specialist registration category of **Fire Specialist** for people already registered as ECSA professionals Pr. (Eng/Tech/Techni) and confirmed to be competent in all the areas of Fire Engineering based on further education, training and experience.

2. CHALLENGES OF NO ECSA REGISTRATION CATEGORY FOR FIRE ENGINEERS

Fire Engineer is not a registered ECSA discipline/category, nor do they have a formal tertiary education basis in South Africa yet and therefore it cannot be a registration category for ECSA. This will be a secondary registration for registered Pr. Eng/Tech/Techni with further training and experience in the fire specialist category. It will entail a written application and report with a validation process by experienced professional in this field. The few people with an international Fire Engineering qualification could also register directly as PR. (Eng. /Tech/Techni) Fire Specialist application, since all 11 required outcomes are performed by Fire Specialist (Fire Engineers).

ECSA has already approved the Fire Practitioners categories which could do design and installation based on deem to satisfy SANS standards and guides but are not deemed to be competent under the National Building Regulations Act, since they cannot register as Pr. Eng/Tech/Techni and do not have the education or training to do complex fire rational designs which require interdependence of multiple performance based parameters for fire safety. The Fire Practitioners will be appointed as a FORM 3 as per Table C.1 SANS 10400-A

Annex C
(informative)

Appointment of competent persons

This part of SANS 10400 relies upon competent persons to perform specific tasks. Competent persons (fire engineering) are required to

a) undertake rational designs in accordance with the requirements of BS 7974 (see 4.1.1(b) and annex B);

b) rationally assess the acceptability of erecting a lapa against an existing building (see 4.12.2.3); and

c) rationally design refuges (see 4.16.8).

Competent persons who might or might not be competent persons (fire engineering) are required to perform a number of other activities. These are set out in table C.1.

Table C.1 — Responsibilities assigned to competent persons other than competent persons (fire engineering)

Clause	Responsibility
4.2.7, 4.4, 4.8.2, 4.16.4, 4.26.1, 4.36.1 and 4.48.6	Design, install and maintain an automatic sprinkler system in accordance with the requirements of SANS 10287.
4.12.2.5	Design and install a lightning protection system in accordance with the requirements of SANS 10313 and SANS 62305-3.
4.25	Design, install, test and maintain the pressurization of emergency routes, mechanical smoke or heat control systems, and components in accordance with the requirements of EN 12101.
4.31.1, 4.31.2, 4.31.3, 4.43.2, 4.48.3 and 4.48.6	Design, install and maintain a fire detection and alarm system in accordance with the requirements of SANS 10139.
4.36.1	Design, install and maintain a fixed automatic fire-fighting system that is in accordance with the requirements of SANS 306-4 or SANS 14520-1.
4.37.3	Install, maintain and service portable fire extinguishers in accordance with the requirements of SANS 1475-1 and SANS 10105-1.
4.52.4	Direct the construction and installation of a tank in accordance with the requirements of SANS 10089-3.
4.53.1.1	Design, erect and protect liquid petroleum gas storage in accordance with the requirements of SANS 10087-3.
4.52.4 and 4.53.1.3	Direct the installation of a diesel fuel tank and associated equipment in accordance with the requirements of SANS 10131.
4.55.1	Perform a rational assessment of building materials and components to determine their fire resistance.

Due to many ECSA professionals signing Form 2 as competent persons to comply to SANS10400-A but without comprehensive experience or training in fire the Building Control Officers and Fire Chief requested ECSA to do validation of registered Professionals as competent in Fire Engineering designs. Unfortunately, this was done by interviews with experienced Engineers doing

"fire engineering" design but without a framework report and documented skills assessment like when Pr. Registration is done. Approval of the new secondary registration as Fire Specialist will include a full assessment based on 11 outcomes specific for fire engineering design. This secondary registration should be available for any Pr. Engineering Discipline. Currently the majority of Pr's practising as Fire Engineers together with their base discipline are from Civil and Mechanical Engineering but there are a small number from all other disciplines.

3. SOUTH AFRICA URGENTLY NEEDS CATEGORY FOR COMPETENT FIRE SPECIALIST

Fire statistics only available for 2015 South Africa:

- Direct Fire loss figure close to R3bn
- Fire Deaths 420 people per annum
- Devastating fires in informal settlements including deaths
- Number of Government buildings had Fires including death of 3 fire man in recent fire in Johannesburg
- Knysna Fires 7 deaths and R3bn more damage just for the one event in 2017
- The SANS standards are dated and very limited but accepted for high risers and buildings with large number of people which was not intended nor are the many practitioners "Consultants" competent to do rational designs. Rational designs by competent **Fire Specialist** (Fire Engineers) for all larger, higher. more complex or higher risk or industrial very high risk is required to ensure a fire safe place is designed for public and employees based on performance-based engineering science.

4. HISTORY OF FIRE ENGINEERING

Fire protection engineering is a new field, but centuries old in practice.

After the Great Fire of London in 1666, which destroyed more than 80 percent of the city, London put its first fire protection regulations for buildings into place, requiring the use of brick and stone exteriors to reduce fire spread.

When cities began to grow in the 18th and 19th centuries, the study of fire events, led to better fire protection methods, as well as codes and standards for the built environment to protect the public.

In 1903, the Armour Institute of Technology created the first-degree program in fire protection engineering.

Today, colleges and universities around the world offer varying levels of study in fire protection and fire safety, but for South African there is limited education by courses and self-study available.

5. DEFINITIONS OF A FIRE ENGINEER

The three design references used for compilation of this report are:

- DEPENDING ON THE COUNTRY, this profession may be called Fire Protection Engineering, Fire Safety Engineering, or simply Fire Engineering.
- Different regions have different definitions and incorporate a wider group of engineering disciplines:

The definition of **Fire Safety Engineering** by the Institution of Fire Engineers of the UK is:

"The application of scientific and engineering principles, rules (Codes), and expert judgement, based on an understanding of the phenomena and effects of fire and of the reaction and behaviour of people to fire, to protect people, property and the environment from the destructive effects of fire."

- The definition of the **Society of Fire Protection Engineers** of the US is:

“Fire protection engineering is the application of science and engineering principles to protect people and their environment from destructive fire and includes: analysis of fire hazards; mitigation of fire damage by proper design, construction, arrangement, and use of buildings, materials, structures, industrial processes, and transportation systems; the design, installation and maintenance of fire detection and suppression and communication systems;

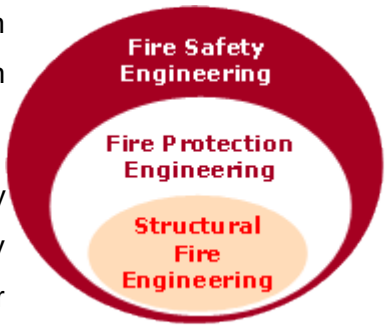
and post/fire investigation and analysis."

Professor Colin Bailey's, of the University of Manchester further explains on the university's website Structural Fire Engineering as:

"What is Structural Fire Engineering

Structural fire engineering is not widely understood by those outside the discipline. Many people confuse structural fire engineering with fire protection engineering, and fire safety engineering. The confusion may arise from the different terminology used by different people in different parts of the world.

Basically, the terms 'Fire Safety Engineering', 'Fire Protection Engineering' and 'Structural Fire Engineering' can be established in the hierarchy as illustrated in the figure. In a simple statement,



"**Fire Safety Engineering** is a multi-discipline to determine fire safety strategy for buildings under fire conditions, in which structural stability and control of fire spread are achieved by providing active and/or passive fire protection.
Structural Fire Engineering deals with specific aspects of passive fire protection in terms of analysing the thermal effects of fires on buildings and designing members for adequate load bearing resistance and to control the spread of fire."

In principle, structural engineers should be aware of all the requirements relating to fire safety in the building regulations. A very common performance requirement is that "Any building shall be designed and constructed so that, in the event of fire, its stability will be maintained for a reasonable period."

So, it is important to understand the basic fire safety measures for buildings and learn the benefits of applying Structural Fire Engineering to achieve these goals."

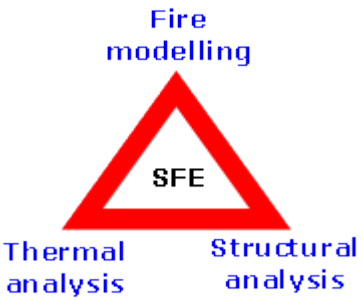
Professor Colin Bailey's, of the University of Manchester further explains on the university's website Structural Fire Engineering as:

"Structural Fire Engineering

Structural Fire Engineering deals with specific aspects of passive fire protection in terms of analysing the thermal effects of fires on buildings and designing structural members for adequate load bearing resistance, i.e. the structural fire resistance.

The well-known practices include the provisions of fire protection systems to steel members and additional concrete cover to reinforced concrete members.

In fact, SFE covers a wide range of levels of knowledge and competence. A generic SFE analysis and design shall involve fire modelling, thermal analysis and structural analysis.



However, the theory and procedures for analysing structural behaviour under fire conditions is much more complex compared to those for structural analysis and design at normal temperatures. Simplified approaches become an important option to most practitioners.

For convenience, the procedure of SFE analysis and design can be divided into three levels of complexity.

The simplest procedure is given in most conventional building codes. Generally, building codes specify the fire resistance required for structural members and classification of construction based on the results of standard fire tests. Information on member dimensions and construction details with respect to fire resistance ratings is provided. The key feature is to keep the structural members "cool" from the heat of fires.

The designers need only apply specified construction features to satisfy the code requirements and require little or no knowledge of fire and structural engineering. This procedure is prescriptive-based.

The second procedure involves the calculation of structural fire resistance based on the empirical or

theoretical relationships. Basically, the mechanical properties of the structural materials at elevated temperatures are incorporated into the traditional structural theory to develop a rational analytical procedure for predicting structural behaviour under fire conditions. This procedure, in a manner analogous to design at normal temperatures, is performance-based and provides more flexibility to designers.

The third procedure involves the assessment of three basic aspects comprising the likely fire behaviour, heat transfer to the structure and the structural response. The overall complexity of the procedure depends on the assumptions and analytical methods adopted to predict each of the three design aspects. Although this procedure normally needs to be performed by experienced structural engineers with the help of professional computer programs, it provides a platform for innovative design and construction features."

- No matter the title used, the concept for this engineer is to identify risks related to fire and determine ways to reduce the risks, as well as design ways of safeguarding against the wrath of fire.
- Similar to other types of engineering, **fire protection engineering** is the application of **science and engineering principles.**
- The principles when working with **fire protection relate to protecting both people and the environment**, built and natural, **from the hazards of fire**.
- This includes **analyzing fire hazards**; **mitigating fire** through **building design** and **construction**; examining **building uses and industrial processes**; and **design, installation, and maintenance** of **fire detection and suppression systems**.
- Through the application of science and engineering principles, the engineer can mitigate, detect, control, or suppress a fire with consideration of the reaction and behaviour of people to fire,
- Should a fire occur, post-fire investigation and analysis also fit within the fire protection engineering domain.

- International Fire Engineers have developed rational fire engineering design methodologies starting from the people and occupancy at risk and then do rational fire engineering performance-based designs based on based on proven design codes and standards as well as latest research bulletins from fire laboratories (LPCC loss prevention council, FM Global (Federal and Mutual), NFPA, etc.) This makes their fire engineering designs responsive and agile to immediately affect alternatives to prevent the causes of global fire incidents and catastrophic failures. The primary objective is still people life safety but given devasting effect on business and cost of fires running into billions of dollars annually latest development also focus on property protection and fire prevention.

6. ROLES IN FIRE PROTECTION ENGINEERING (FIRE SPECIALIST)

Looking at some of the roles a Fire Protection Engineer (FPE) can play helps to identify the interdisciplinary nature of the field:

- These engineers can be found working as consultants, forensic investigators, fire department and government employees, fire equipment and system manufacturers, facilities managers, insurance industry representatives, research laboratory technicians, university staff, or even in the entertainment industry.
- Opportunities are endless because fire is a risk to everyone. To make the world safer from fire risks, FPEs work in many disciplines.
- FPEs have expertise in a variety of areas that can include, but are not limited to, structures, mechanical systems, risk management, fire dynamics, occupant movement, and wildfire management.
- The combination of disciplines has led many to a career in fire protection, even when their formal studies may have been in other disciplines.

7. PROPOSED SPECIAL SECONDARY REGISTRATION

Developing Fire Specialist new registration for competent Rational Designer Pr. For:

- Professional Engineer (Pr Eng)

- Professional Engineering Technologist (Pr Tech Eng)
- Professional Engineering Technician (Pr Techni Eng)
- Professional Certificated Engineer

Lacking the formal registration as Fire Specialist there are many self-declared Fire Consultants without any Engineering education practising Fire Engineer on large complex buildings at the risk of the public.

Fire Practitioner (already ECSA approved and registrations done but not competent for rational fire design only sub-areas detail design DMTS)

- Sprinklers
- Detection

Formal Registration for Fire Specialist will allow:

- Participation and access to world-class information, education, credentialing and advocacy. Connect with the best international minds in fire protection and fire safety engineering, advance careers, and make a difference by getting involved.
- Support growth of local education capacity and continued professional training.
- Foster International relationships with professional Fire Engineering associations and education and knowledge groupings.

8. EDUCATION AND DEVELOPMENT UNTIL TERTIARY EDUCATION WILL BE IN PLACE

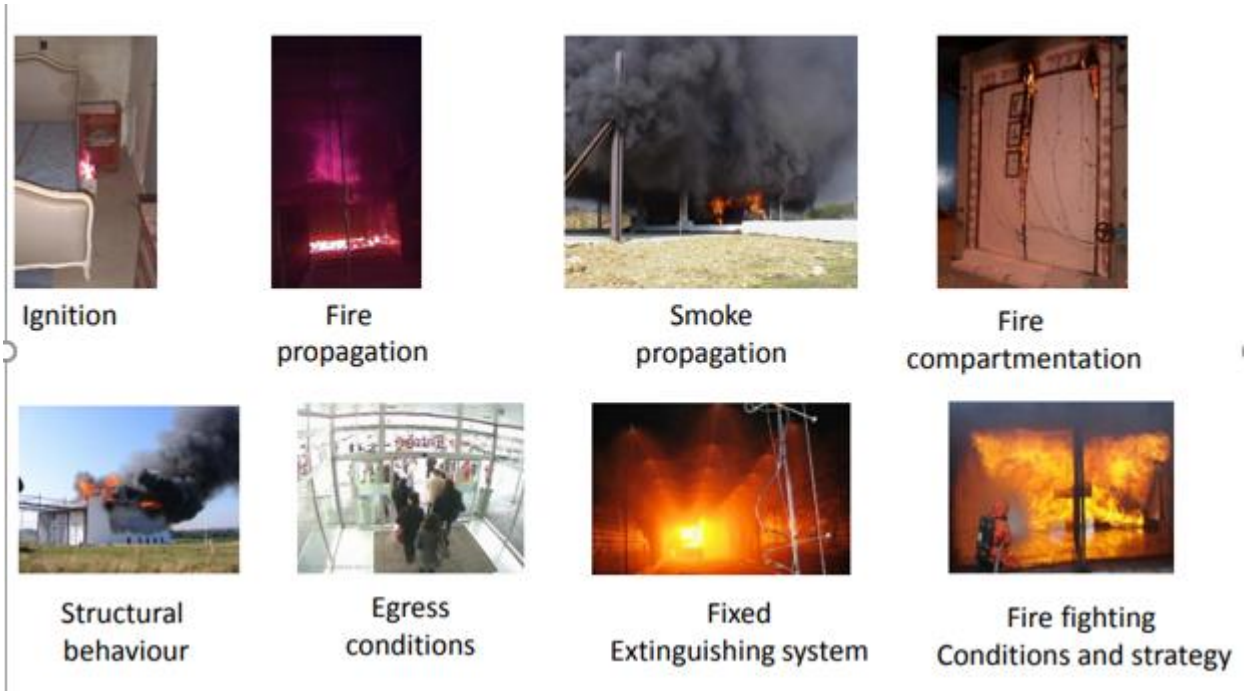
Short Courses in Fire Safety topics by University of Stellenbosch, various training organizations in specialist areas, Society of Professional Fire Engineers Technical handbook (4000 pages) and international codes and standards as well as training with experienced companies.

9. TRAINING FRAMEWORK FOR REGISTRATION:

Will be finalized with Education groups but typical in countries where fully established includes:

Higher education programs in Fire Engineering and related disciplines like:

- Fire Engineering Rational Design methodology
    - Qualitative Design Review
    - Quantitative Analysis
    - Design fire scenario
    - Fire Safety Engineering Acceptance Criterion
- Fire Safety Systems and Performance Designs
- Combustion Theory
- Fire Dynamics & Modelling
- Fire Induced Flows
- Human Response to Fire
- Industrial Safety
- Investigation and Reconstruction
- Material Flammability
- Risk and Hazard Analysis
- Smoke Detection and Management
- Smoke Control Modelling and Design
- Suppression systems (Sprinkler, misting, gaseous, etc) and Compartmentation
- Means of escape in case of fire
- Firefighting systems and equipment (Fire hydrants, Fire hose reels, tanks, pumps, pipes, etc.)
- Structural stability fire designs



10. POST GRADUATE STUDIES IN FIRE ENGINEERING:

Dr Richard Walls Pr.Eng. is a lecturer at University of Stellenbosch and has 20 post graduate students doing Masters and PHD degrees in fire at this stage.

Some MEng thesis cover topics such as:

- Fire dynamics and design
- Structural fire engineering
- Informal settlement fire safety
- Fire modelling

Core Fire taught modules

- Fire dynamics
- Structural fire design

There is also PHD research on informal settlement fires and testing which will be driven by industry Fire safety research requirements.

Dr Walls is supported by Fire Engineering Division of SAICE and larger businesses to seek further funds to appoint more lecturers to establish a Fire Engineering graduate course over the next 3-4 years. This will allow a category of Fire Engineering to be registered with ECSA once an education basis complying to ECSA requirements are available.

11. PERFORMANCE BASED AND RATIONAL FIRE SAFETY DESIGNS:

Safety is a social responsibility that has been met worldwide through the effective use of a regulatory framework that carefully balances the use of codes, standards and professional practice. The purpose of this regulatory framework is to guaranty that buildings and infrastructure meet societally acceptable levels of performance and fire safety. Various performance-based methodologies exist internationally. One of the recognised methodologies is BS 7974 and referenced in the SANS 10400-T standard and therefore applied in South Africa together with other appropriate International performance based methods and codes.

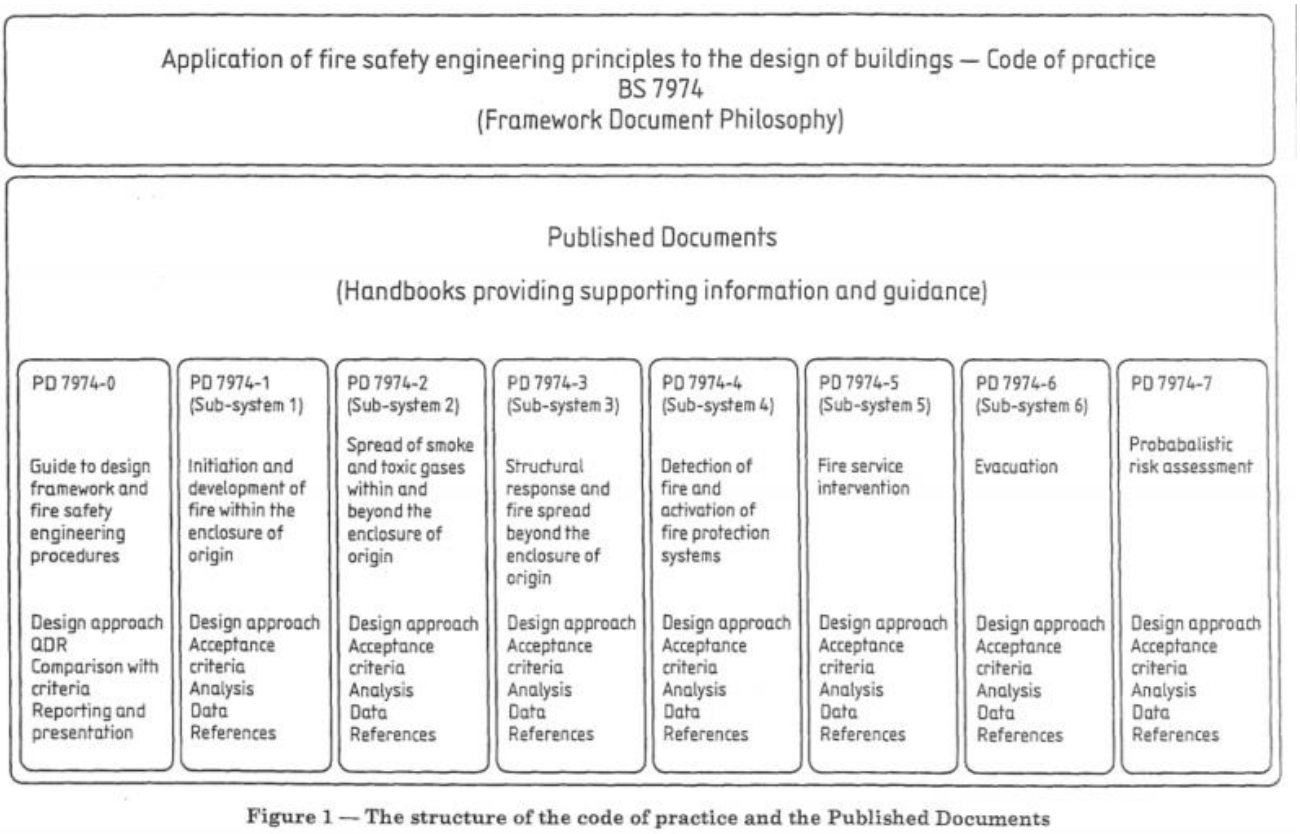


Figure 1 — The structure of the code of practice and the Published Documents

12. ECSA REGISTRATION VALIDATION

ECSA FIRE PROFESSIONAL (FIRE ENGINEER)

PROPOSED COMPETENCIES

The Fire Specialist Competencies will be based on the Engineering Council 11 competencies and set out the related skills and knowledge of the discipline of fire engineering.

The Fire Engineer is expected to apply South African Regulations and standards and for more complex performance-based designs applies International more extensive codes standards like UK: BS, EU: ISO or EN, USA: NFPA, etc. to be fully competent for alternative /rational fire safety designs. The Fire Engineer must, however, have broad based experience and detail knowledge/experience in some specialist categories of one or more aspects of fire engineering as well as some knowledge of related aspects.

Categories of registration as per ECSA Requirements:

a) Professional, which is divided into:

i. Professional Engineer;

ii. Professional Engineering Technologist;

iii. Professional Certificated Engineer; or

iv. Professional Engineering Technician.

Current incumbents must be registered under any of these categories and have and 3 years' experience and fire post graduate and/or short courses and in-job training in Fire Engineering to apply for Professional Registration on NRS. Qualifications in disciplines of Civil, Mechanical, Electronic, Chemical will be typical candidates. Engineering Fire qualification does not exist in South Africa and therefore will be an extension of existing disciplines in South Africa. International qualification in fire will be validated by the relevant ECSA accreditation committee for registration purposes on request.

13. RECOMMENDATION TO ECSA BOARD

It is recommended that ECSA approves a new special secondary registration category, **Fire Specialist** to recognize competence of Pr. Eng./Tech/Techni, with training, experience and competence in Fire Safety Engineering, until educational basis will be in place in several years to register Fire Engineers as a Pr. category.

Fire Departments, building control officers, and public will, with this registration have the assurance that competent Engineering professionals are attending to Fire Safety designs. This includes regulatory as well as life safety systems. It will drive the same professional conduct and stature for Fire Specialist as other professional engineer categories. This registration will be available for all engineering disciplines who are registered as Pr. and specialise in fire engineering.

LIST OF REFERENCES

- *SANS 10400-A, T, W and related standards*
- *BS EN 7974: 1-8 Application of fire safety engineering principles to the design of buildings*
- *Society of Professional Fire Engineers USA Redbook and training and licensing frameworks.*
- *OHSACT-Engineers to design safe environment for the public and employees*
- *Many International Fire Safety standards & codes and professional fire societies in a number of countries as well as education frameworks from international universities with graduate and post-graduate courses for Fire Engineers.*