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DEVELOPING FIRE SAFETY ENGINEERING IN AFRICA – AN EDUCATIONAL SPARK IS SLOWLY BECOMING A CONTENTAL FLAME

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INTRODUCTION

As the population, mining activities, informal settlements, cities and industrial centres in Africa continue to grow at an alarming rate there is an important question to be asked: how can we keep Africa fire safe? In the developed world it can be seen that fire safety engineering (FSE) has made significant progress in protecting people, assets and the environment from the destructive effects of fire. The consultants and practitioners developing FSE solutions have often been trained through formal university programs. However, the FSE degree programmes in countries such as the USA and UK are many decades old, require extensive resources, and have highly trained staff members with rare skills. Until recently Africa had virtually no formalised university training for consulting fire safety engineers. This article gives a short introduction to fire safety educational work that has been developing on the continent in the past few years.

Structural fire engineering research at Stellenbosch University (located in the beautiful winelands outside of Cape Town, South Africa) started in 2014 with a single PhD study. Through this study and ongoing research other students and team members have gradually became involved. In 2017 the Fire Engineering Research Unit at Stellenbosch University (FireSUN) was founded, with a focus on developing technical expertise in fire safety. The team has now expanded to currently have around 20 students, including 6 PhDs, 7-9 research masters students, 2 postdoctoral fellows and 4-5 final year students working on fire safety research topics. Two formal postgraduate taught courses have been developed, namely structural fire engineering and fire dynamics. A third course on the fundamentals of fire safety engineering design is currently being developed.

However, even more exciting than the development of FSE research at one university is the fact that FSE is slowly starting to have an impact in multiple countries. In 2020 students and staff from the University of Zambia, University of Nairobi (Kenya), and Central University of

Technology (Bloemfontein, South Africa) will be attending some of the courses being developed. Furthermore, students and consultants from other countries are starting to get involved, such as in Namibia and Nigeria. The location of these groups is shown in Figure 1. All this represents a big step forward in a field that has been heavily neglected on the continent.

Figure 1: Locations of universities or individuals getting involved in developing fire safety in Africa. Hopefully the work will spread across much of the continent.

SUPPORT FOR THE WORK

Fire safety education not only requires multiple staff members but also expensive equipment and laboratories. Hence, there has been a number of interim steps in developing the capacity to undertake research, teaching and testing. A large project on informal settlement fire safety in collaboration with the University of Edinburgh, sponsored by the EPSRC (UK), helped the initial work. Additional assistance was then obtained from the Lloyd's Register Foundation (UK) to specifically focus on the educational development of fire engineering, through assisting in sponsoring the creation of two taught postgraduate

courses (structural fire engineering & fire dynamics). In 2020 a second educational grant has been received through the Engineering X program by the Royal Academy of Engineers and Lloyd's Register Foundation together. This is allowing for the creation of a third taught course on the fundamentals of fire safety engineering (to be rolled out late 2021/early 2022), and to also make the new courses 100% online, such that they can become more widely accessible. Due to the limited staff capacity available, and the large geographic distances between participants, the team has rapidly embraced online teaching and technology to promote FSE education, as shown in Figure 2. Local fire testing has been made possible through generous support by a local fire testing laboratory in Cape Town, Ignis Testing. It has been exciting that a small research team has been provided with access to standard fire test furnaces and other facilities.

The development of highly technical postgraduate courses is also not possible without technical input and assistance. To this end the University of Maryland, along with academics from other universities, have provided initial guidance on the establishment of fire dynamics courses. Prof Erica Fischer from Oregon State University visited South Africa in 2019 and helped run two structural design seminars for industry participants. The National Fire Protection Association (NFPA) has provided advisory assistance and access to material to bolster the efforts. The SFPE core competencies and degree curricula have formed the basis for guiding the development of educational content (although it will be a number of years before all aspects can be addressed).

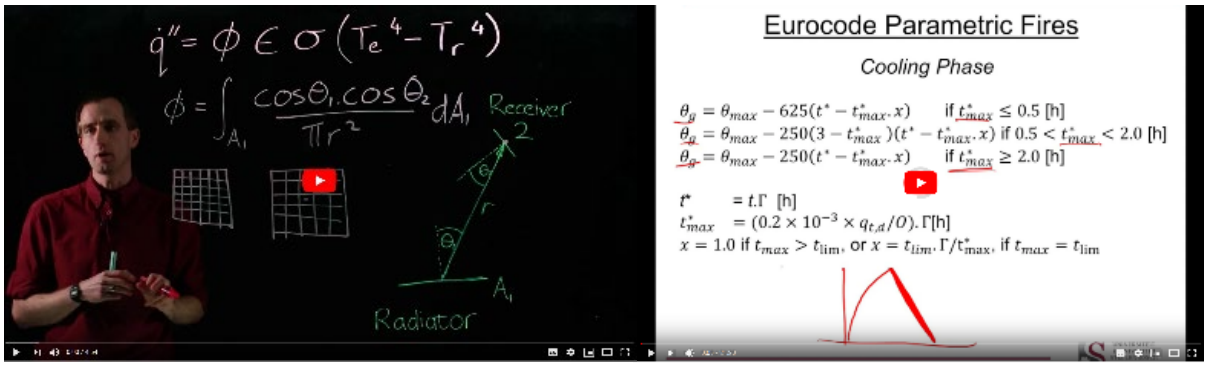

Figure 2: Embracing the electronic world - the development of fire engineering has rapidly gone online at Stellenbosch University. Here are YouTube explanations on the calculation of the configuration factor for radiative heat transfer and Eurocode parametric fires

WE'RE NOT ALWAYS AS FAR BEHIND AS YOU MAY THINK…

An advantage of having a young, energetic team in a country/continent with minimal academic fire engineering knowledge is that a variety of unusual projects have been started, with some of these being shown in Figure 4. This has allowed innovative research to be conducted in relatively new fields.

Some of these include:

- Informal settlement fire safety testing, modelling and development of guidelines
- Development of fire spread models for large informal settlement fires
- Development of fire safety products using 3D printed concrete
- Testing of Ecobrick walls in fire. (Ecobricks are highly popular plastic bottles that are filled with non-recyclable plastics and waste material, and then built into walls

such as for schools and crèches in developing countries. [Many a fire engineer reading this is currently worried about the combustible plastics being put into public buildings without understanding their usage.])

- Development of novel cellular steel structures through large-scale testing. The largest standard testing furnace in Africa (4x6m) was developed by Ignis Testing Laboratory (a local partner) to assist this work.
- Understanding fires on passenger trains based on the extensive number of arson attacks that have occurred in South Africa. This being done under the national passenger train agency.
- Timber structures in fire, including connection modelling.
- Analysis and benchmarking of test standards for South Africa.
- Computational modelling of large structures.
- Fire modelling
- Petrochemical facility fire safety

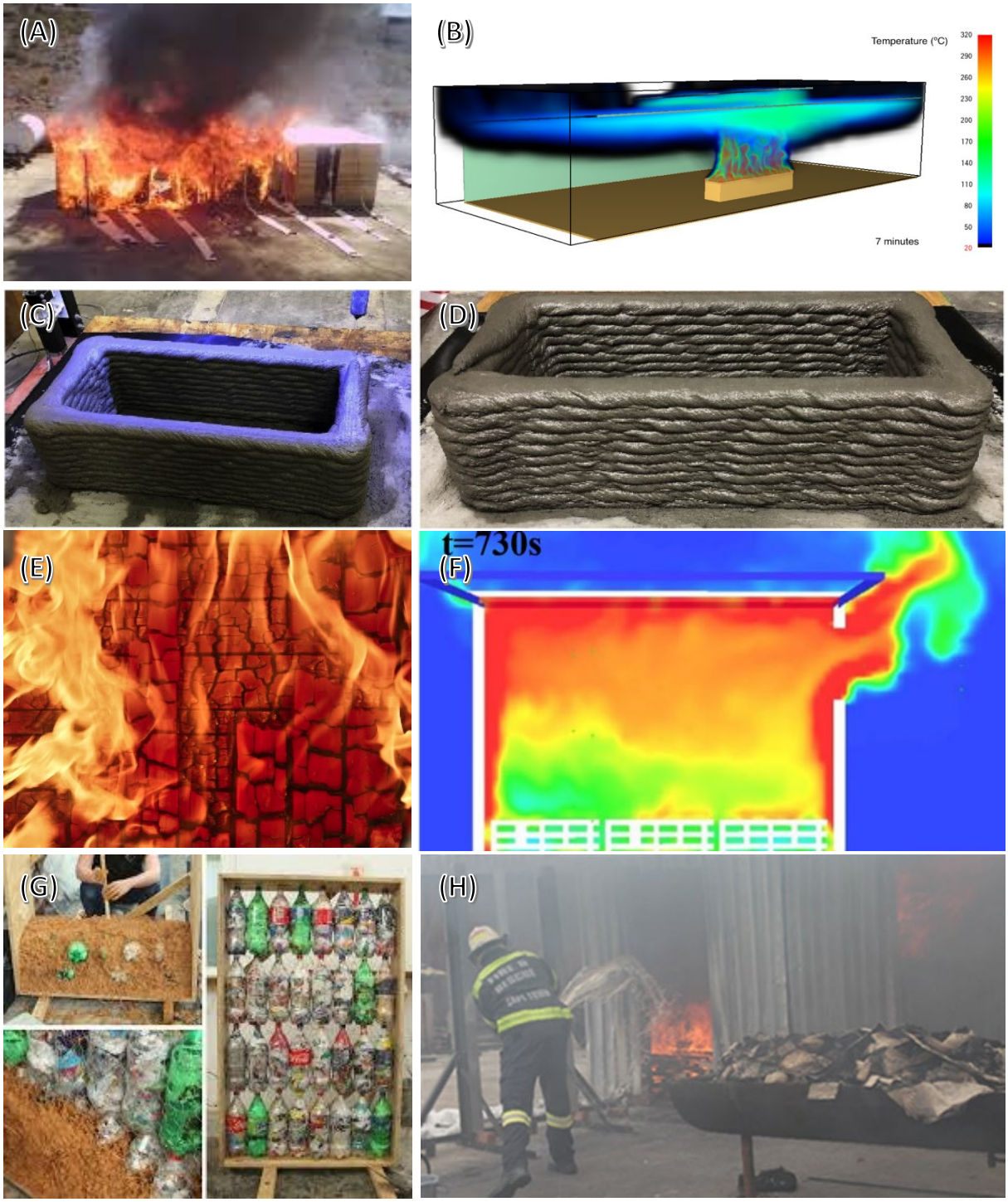

Figure 3: Examples of research or consultanting projects currently underway: (A) Large-scale testing on informal settlement dwellings, (B) model of a burning train in a manufacturing facility, (C & D) 3D printed concrete being tested for fire resistance, (E) charring of South African pine in a furnace test, (F) computational modelling of an informal settlement dwelling, (G) testing of Ecobrick walling systems, (H) benchmarking of suppression products for informal settlements (including bucket brigades and proprietary products).

CONCLUSIONS

There is a huge fire safety educational mountain to be climbed to develop a thorough fire

safety engineering curriculum at multiple universities on the African continent. However, there is progress, and hopefully in the years to come Africa can start solving her own fire safety problems by producing well-trained engineers. Partnerships with leaders around the world is making all of this possible.