The 1973 Summerland disaster — lessons to the building industry from the process industry

Benjamin Khoo & Janet Skitt, Imperial College London, UK

Summary

On the 14 June 2017 in West London, a devastating fire broke out in Grenfell Tower. The fire spread over 20 floors via the building façade and killed 72 people, making it the deadliest structural fire in the UK since Piper Alpha in 1988. However, this was not the first incident where a fire spread externally over the façade; the Summerland fire on the Isle of Man on the 2 August 1973 shares many similarities to the Grenfell fire.

This paper intends to provide an account of the Summerland fire, drawing parallels between some of the key issues underpinning the systematic failure in the construction industry, before reviewing how the construction industry could learn from the process industry on improving safety management and procedures.

Keywords: Fire, safety management

Introduction

At 8:00 p.m. on 2 August 1973, Summerland, a leisure centre on the Isle of Man as shown in Figure 1, was seen to be on fire. Figure 2 shows where the fire initially started, and it spread quickly over the building façade. While many escaped the inferno unharmed, the incident claimed 50 lives and seriously injured 80.

To understand the circumstances leading to the fire, the Hon. Mr Justice Cantley was appointed to chair an inquiry into the incident. As part of this the commission was able to establish a relevant timeline. All timings are approximate, as determined by the inquiry.

The fire was caused by an accidentally discarded lit cigarette at a kiosk on the outdoor terrace at 7:40 p.m. This initial blaze was detected early by staff, and a firefighting party acted to keep it under control. Unfortunately, this fire-fighting attempt was unsuccessful and around 7:46 p.m. the fire spread to the façade.

The fire brigade was notified of the fire at approximately 8:00 p.m. when the manually activated Summerland alarm sounded in the fire station. At about the same time, the fire broke into the amusement area of the building and began to spread rapidly through the building. Firefighters arrived at Summerland at 8:07 p.m. but could not actively fight the fire due to severe heat and burning debris falling from the building.

At 8:11 p.m. the Summerland house manager switched off the main electricity supply with the intent of preventing an

Figure 1 – Summerland before the fire, much of the exterior is covered with Oroglas façade

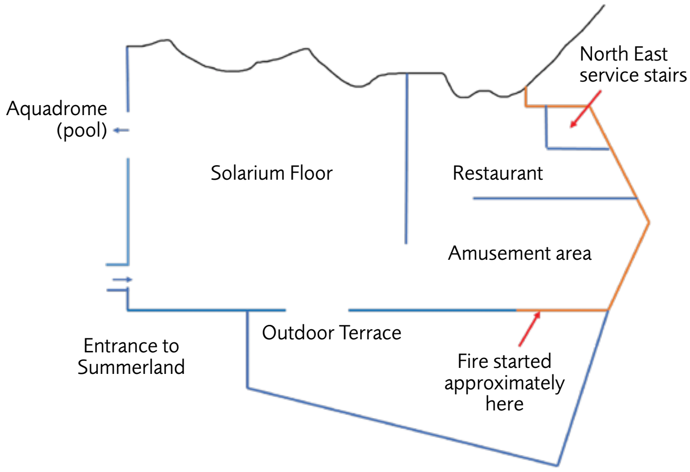

Figure 2 – Floor plan of the solarium level. The orange line represents Galbestos, a flammable material

electrical fire. This resulted in complete darkness within the building. It was only at 9:10 p.m. that the fire was brought under control[1].

How did this occur?

After the incident, questions were raised regarding the designers choice of construction materials, and the suitability of building regulations[2]. However, a failure in fire safety of this magnitude is rarely due to a single issue and is often due to the collapse of multiple defences. Therefore, it is essential to understand the independent protection layers (IPLs) between initiating causes and undesirable consequences. The concept of IPLs is a core method of reducing risks in the process industry[3].

0260-9576/19/$17.63 + 0.00

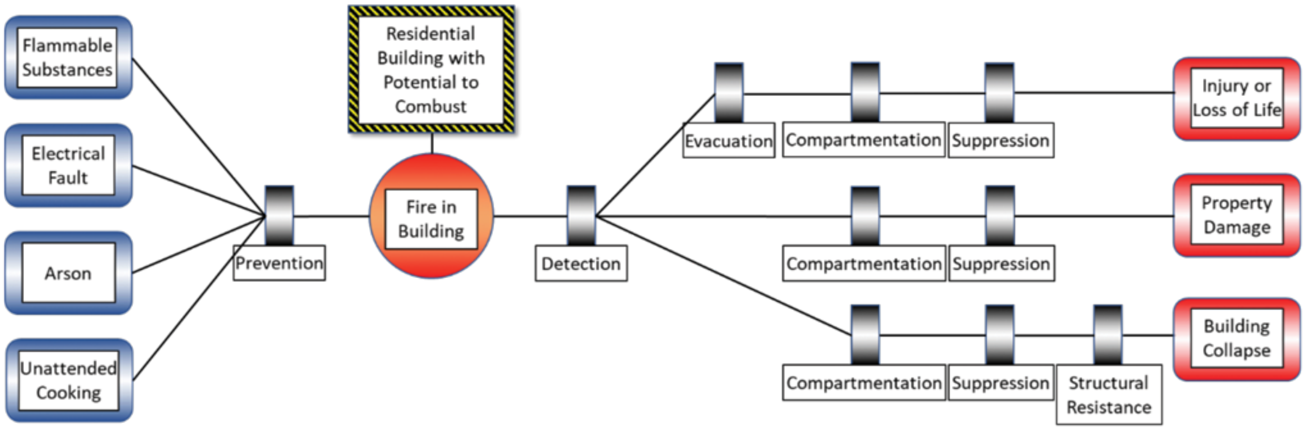

Figure 3 – Simplified Bow Tie model demonstrating IPLS

The fire safety of a building can be split into six IPLs[4,5]:

1. Prevention
2. Detection
3. Evacuation
4, Compartmentation
5. Suppression
6. Structural resistance

In the case of the Summerland fire, only the structural layer remained intact. A basic bow tie model, as shown in Figure 3, shows the function of each IPL. If the prevention layer is breached the remaining layers then act independently and sequentially, to ensure minimal damge to both life and property.

It is important to note that not all buildings consist of these six IPLs. For example, in the UK, the compartmentation layer is often focused on, while in the USA, more emphasis is given to the suppression layer.

Prevention

The prevention layer ensures no self-sustaining fire can take place in the building, via the construction of vulnerable areas using non-flammable materials.

The Summerland building façade predominately consisted of three different materials: Oroglas — a transparent poly(methyl methacrylate) (PMMA) sheet; Galbestos — a corrugated steel sheet coated in a mixture of asbestos and bitumen; and Decalin — a sound absorbent fibreboard. Flammable Galbestos and Decalin were used as substitutes for non-combustible materials, but without a thorough understanding of their properties. Figure 4 shows how they were installed on Summerland.

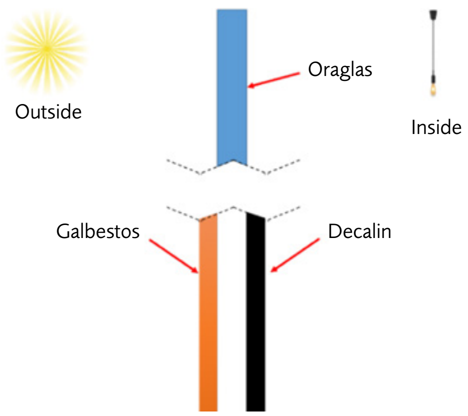

Figure 4 – Two types of façade on the Summerland building, the transparent section (top) and opaque (bottom). Note that in certain areas Galbestos was present without Decalin.

The façade is considered one of the vulnerable areas of a building that must not contribute to flame spread. On the Isle of Man, all façade materials were required to be non-combustible with a 2-hour fire resistance, by byelaw 39[6]. However, insufficient knowledge and miscommunication between designers, manufacturers and authorities allowed these materials to be approved[1].Poor understanding of how the materials behaved in combination also contributed to the failure, with an internal cavity between the layers accelerating the spread of flames[1].

Detection

The detection layer exists to inform both residents and emergency services of a fire. This can be achieved by installing detection systems such as fire alarms in the building.

At Summerland, despite the fire being detected early, the automated alarm system failed to notify visitors and the fire brigade immediately. This was due to unauthorised modifications to the system, made to delay the audible alarm and automated call to the fire brigade, allowing staff more time to investigate false alarms[1].

As a result, the fire brigade was only notified 20 minutes after the fire started.

Evacuation

The evacuation layer enables the safe abandonment of the building for all users. The failure of this layer in Summerland can be attributed to ill-defined responsibilities within the management. Part of the Summerland general manager's duties was to organise staff training. This was not implemented and resulted in poorly trained staff who provided limited evacuation instructions, failed to unlock all emergency exits and switched off the main electricity supply, severely hampering the evacuation effort[1]. The inquiry also found that some staircases were not wide enough for evacuation purposes, further restricting the safe escape of personnel[1].

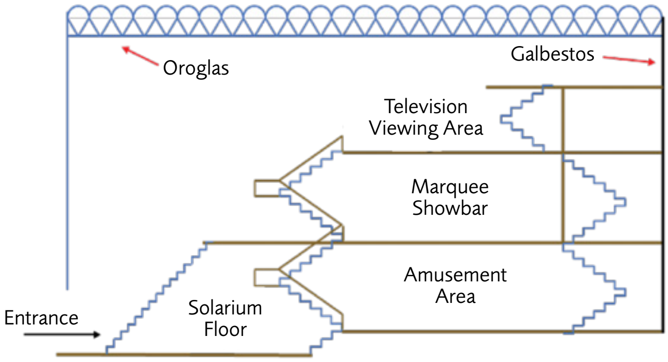

Figure 5 – Internal layout of Summerland

Compartmentation

The compartmentation layer ensures that fire does not spread quickly throughout the building. This gives additional response time for firefighters and evacuation.

At Summerland, fire compartmentation was compromised by a flammable façade and roof. This, combined with the single large compartment design, shown in Figure 5, allowed fire and smoke to spread rapidly throughout the building[2].

In addition, the unauthorised modification of a fire door by Summerland management affected the compartmentation of one of the escape routes[7].

Suppression

The final protection layer which failed in the Summerland fire was suppression. The function of this layer is to suppress a fire or to slow down the spread[8]. The suppression system can include both sprinklers and manual fire control by trained operators, as well as other features.

The breach of the suppression layer at Summerland could be attributed to a lack of sprinklers. Despite the recommendation from the Oroglas manufacturer to install sprinklers in the building, the management felt that a sprinkler system was unnecessary[1,2]. The only active fire suppression available was local firefighting equipment for use by trained operators, however, the inquiry concluded that staff were not trained to use this[2].

Learning from process industries

Ten years after the Summerland fire one of the inquiry team members stated that lessons from Summerland had not been learned and many deficiencies were still "inherent in some current concepts..."[9]. An independent review into building regulations and fire safety, chaired by Dame Judith Hackitt, was instigated after the deadly Grenfell Tower blaze in 2017. The final report, released in 2018, highlighted a central issue of "an industry that has not reflected and learned for itself, nor looked to other sectors"[10]. This section covers how the process industry has addressed some of the issues raised in this incident, and how these lessons could be utilised by the construction industry.

One of the main reasons the Summerland disaster became so significant was the loss of compartmentation. Use of the flammable façade was based on approval of individual components, instead of assessing their use as an interacting system. Despite the inquiry conclusions there have been subsequent occasions where compartmentation has been lost via building externals. Several façade fires have occurred in the UK since Summerland, with Lakanal House in 2009 being particularly well documented.

The process industry requires safety reviews to be performed at various stages, and for modifications to be assessed as part of the whole process. The Hackitt review recommended the use of a "systems based" approach, avoiding perfuntory box ticking that covers limited scenarios, dates rapidly and encourages minimum standards[10]. This reflects the changes made to offshore legislation following Piper Alpha in 1988. It was recognised that prescriptive systems can fail due to their limited scope, and instead goal-orientated methods should be used[11]. It has also been suggested that methods such as HAZOPs, Failure Modes and Effects Analysis (FMEA) and bowtie diagrams are suited for identifying risk in many industries[12]. Focusing on outcomes, these techniques require assessors to have a full and dynamic understanding of the whole system, as well as encouraging additional safety measures.

A lack of clarity of who is responsible for maintaining a safe environment led to the poor fulfilment of safety requirements at Summerland. The evacuation effort was compromised by untrained staff and unauthorised modifications of both fire doors and the fire alarm system. Audit trails and maintenance records are requirements in the process industries, often with strict time-based testing and replacement criteria. There are also clear regulations regarding risk, who is responsible and how information is shared. Distributing useful knowledge amongst the process industry has been encouraged for many years. In 1968, following an increase in fatal incidents in ICI, the ICI Safety Newsletters began circulation. The intention was to improve the safety culture of the process industry by sharing information about accidents and near misses. Findings were made available for free, and distribution encouraged.

This, and other similar schemes have been credited with improving attitudes towards safety and avoiding the prioritising of cost in the "race to the bottom" described in the construction industry[10].

A disjointed approach between disciplines at Summerland led to the use of Decalin instead of a noncombustible material, due to its superior acoustic performance. Again, the Hackitt review cited a "lack of coherent and comprehensive approach" without "due consideration to how their work may interact with the work of others" as a major flaw in the existing system[10].

The "Principles of Process Safety Leadership" was published as a result of the Buncefield Standards Task Group investigations, set up as a cross industry board to address issues raised after the Buncefield explosion in 2005. Several core principles were created, including the promotion of safety across the workforce, with clear safety leadership at board level[14]. This was committed to by leaders across the industry in order to improve process safety across sectors.

Conclusion

The tragedy of Summerland has highlighted the failure of the construction industry to learn from previous incidents. Grenfell Tower, which was engulfed in fire 44 years after

0260-9576/19/$17.63 + 0.00

IChemE

Summerland, experienced a breach of the same five IPLs, with only the structural layer remaining intact. The lack of understanding of how products are certified and failure to assess fire safety competently are consistent across both incidents. The construction industry has a lot to learn from the process industries on improving its safety. Primarily the focus needs to be on anticipating all possible risks and lowering them as far as reasonably practicable, working down from the highest level of protection available rather than up from the minimum required. By doing this, a repeat of these disasters can, and must, be avoided.

References

1. *J. Cantley, "Report of The Summerland Fire Commission," Government Office, Isle of Man, Douglas, 1974.*
2. *I. Phillip, "From 21st century leisure to 20th century holiday catastrophe: the Isle of Man Summerland fire disaster", Birmingham: I. Phillip.*
3. *R. Casey, "Limitations and misuse of LOPA," Loss and Prevention Bulletin, vol. 265, pp. 13-16, 2019.*
4. *S. Wong, "Macron's pledge to rebuild Notre Dame in five years may be possible," New Scientist, vol. 3227, 2019.*
5. *S. Wong, "New Scientist," New Scientist Ltd., 16 April 2019. [Online]. Available: https://www.newscientist.com/article/2199991-notre-dames-stonework-isnt-flammable-but-may-be-structurally-damaged/. [Accessed 16 April 2019].*
6. *RIBA, "No villians? The fire commission's report," RIBA journal, vol. 81, pp. 3-23, 1974.*
7. *The Architects Journal, "Summerland: the analysis, the course of disaster, the blame, the recommendation," The Architects' Journal, vol. 159, no. 22, pp. 1183-1188, 1974.*
8. *X. Ye, J. Ma, Y.-x. Shen and L.-Y. Lin, "Suppression effect of sprinkler system on fire spread in large commercial buildings," Procedia Engineering, vol. 135, pp. 455-462, 2016.*
9. *D. Harper, "Memories Must Be Jogged on Summerland's Lessons," Fire, vol. 77, pp. 31-34, 1984.*
10. *D. J. Hackitt, "Building a Safer Future Independent Review of Building Regulations and Fire Safety: Final Report," Ministry of Housing, Communities and Local Government, London, 2018.*
11. *W. D. Cullen, "Public Inquiry into the Piper Alpha Diasaster," HMSO, London, 1990.*
12. *M. Clay, "Hazard Identification - can power engineers learn from the process industries?," Loss Prevention Bulletin, vol. 253, pp. 23-26, 2017.*
13. *PSLG, PSLG Principles of Process Safety Leadership, [http://www.hse.gov.uk/comah/buncefield/pslgprinciples.pdf].*

0260-9576/19/$17.63 + 0.00